

The use of Educational Video (EV) to facilitate learning of Mathematics Education in Grade Ten: A case study of two Secondary Schools in Durban KwaZulu-Natal Province in South Africa.

By

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## Declaration

I, 'Malerato Sebolelo Ncheke, declare that this dissertation is my work and has not been submitted previously for any degree at any University.

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Signature

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Date

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Supervisor

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Date

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- Educational Technology Dream Team '2007'

Mabohlkoa, Moipusi, Mafata. Manone, Peter, Buhle and Julian,

## Dedication

This work is dedicated to my children, Lerato, Tumelo, Lintle and Katleho,

My special gratitude goes to my husband, Khauoe Ncheke for his love and support.

Big thanks go to my younger sister, 'Anti Cici', who assisted my children when I was away.

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## **Abstract**

The integration of technology into teaching and learning has come as new in education. It is a shifting of paradigm from one way of educational thinking to the other. Before entering their classrooms for the first time students already have been using technology devices and educators' cannot ignore this facts. The South African Ministry of Education has responded to this issue by designing implementation strategies and has mandated all schools in the country to have integrated Technology in the curriculum by 2013.

The study anticipated to understand how Educational Video (EV) is used to facilitate learning of mathematics in two Secondary schools in Durban, KwaZulu-Natal Province. The underlying principle was to ascertain the challenges educators encounter in facilitating teaching and learning of mathematics, using EV in two secondary schools in Durban, KwaZulu-Natal Province.

A qualitative research approach and case methodology were used to explore these experiences of educators in mathematics instruction. Semi-structured interviews, classroom observations and documents review methods were used to collect data that were analysed and discussed, using the principles of Engagement and Activity theories. Four purposively selected educators and ten grade ten students were interviewed and their mathematics lessons observed.

The findings indicated that the integration of video in teaching and learning appears to assist both learners and educators in two schools, and the educators from the two Secondary Schools in Durban, KwaZulu-Natal Province. have shown to be comfortable with its use in facilitating mathematics instruction for it enables authentic and higher order thinking in learners by engaging them in complex tasks within collaborative learning contexts. Issues of professional empowerment financial support, and lack of materials, delay the integration of EV in two schools. This would be solved easier if all stakeholders in the education sector were effective in their individual roles for the betterment of education in the whole country

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## LIST OF Abbreviations

ET	Educational Technology
EV	Educational Video
NCLB	No child left behind
ICT	Information Technology
NCTM	National Council of Technology of Mathematics
E-Education	Electronic Education
USA	United States of America
KZN	KwaZulu-Natal
Dr	Doctor
NTTI	National Teacher Training Institute
GET	General Education and Training
FET	Further Education and Training

# CHAPTER ONE

## 1.1 Introduction

The introduction of educational technology (ET), also known as “instructional technology”, has helped to expand the scope and depth of education internationally. Through ET, learners are able to access more information and connect with more people than ever before. Learning furthermore can now be more individualized and learners can access resources that enable them to drive their own learning (Adams and Jansen 1997). Before learners enter their classroom for the first time, many have already been using technological devices such as videos and computers for gathering different types of information. Such preschool experiences should be enhanced in the classroom.

Ellington, Percival and Race (1993, p.3) define “educational technology” as using multimedia technology like audiovisual aids as a tool used to enhance the teaching and learning process. They also point out that educational technology is not just about tools or equipment, as many people believe, but includes the methods, skills, and procedures used in the teaching and learning process which they refer to as educational technology.

The use of multimedia in teaching and learning helps in the development of learners’ abilities, enabling them to become creative, critical thinkers and analysts, as well as problem-solvers. Lindstrom (1994), for example, found that people remember 20% of what they say, 40% of what they see and hear, but about 75% of what they see, hear and do. Video as a tool in teaching and learning therefore has the capacity to enhance teaching and learning by bringing into play senses such as sight, hearing and touch and is now widely employed in most classrooms. Similarly, Felder (1988) observes that educational video (EV) has helped both educators and learners to change the way mathematics is taught and learned, and has helped them improve their performance. He comments that educators have developed a positive perception on the use of video in teaching because it enables learners to explore basic topics in mathematics in ways that cannot be done with the chalkboard, or using a textbook. Adams and Jansen

(1997) state that educational video has been effective in allowing learners to interact with learning in a way that motivates, encourages and challenges their critical thinking. EV also caters for the variations in learning style of each individual learner (Felder, 1988). Nearly all learners, whatever their age or ability, use computers and watch television with the aim of gathering information. For this reason, educators cannot ignore the potential that technology has to assist in teaching and learning, and must apply and integrate technology in their teaching methodology to enable learners to acquire the needed skills to improve their academic performance. Educational video has changed the role of educators from being the only ones who possess knowledge in the classroom. It has enabled them to be facilitators and educators, who set project goals, provide guidelines for resources, make suggestions, and support student activities.

## **1.2 Motivation for the study**

The researcher's interest stems from the fact that she is an educational technology student and a mathematics educator who has been exposed to modules on teaching using technology devices. She has also been exposed to literature on the use of technology in teaching and learning which indicates its great potential for both teachers and learners. A gap is that the researcher has no first-hand experience of the interaction and collaboration that current students and educators engage in with their colleagues around the globe through the use of EV. While she is familiar, from the literature, with the kind of successes that can be achieved in equipping learners with skills to design videos, her interest has more to do with the use of video in the process of teaching and learning than with video design per se. She was motivated to undertake this study by a desire to understand how video is used to facilitate learning of mathematics, and she also wants to understand educators' perceptions and challenges encountered in the use of educational video in the classroom.

Kahn (2004) reported that according to the Department of Education only 4% of Grade 12 learners in each year have passed mathematics in higher Grade in the last five years. The present study seeks to understand the contribution of EV in the teaching of mathematics in two selected schools.

The researcher was interested to undertake this study, in a field which both international and local researchers have explored, with the aim of further investigating the status of mathematical education in the local South African context. International work includes the studies done by Lightbody (2007) in Australia, Crean (2001) in America, and Hatfield and Bitter (1994) in South Africa. These researchers' field of interest focused on ways in which learners perform exceptionally when provided with video designing skills. Their findings therefore focus more exclusively on the technical aspect of using video, rather than on how it assists learners in learning mathematics, while the researcher's concern is with the use of technologies, especially educational video, in teaching and learning environments, and with the performance of learners in mathematics education, which seems to be gradually deteriorating (Lubisi and Cronje 2007). In this study, the researcher intends to investigate the use of EV to facilitate the learning of mathematics.

Gutierrez (2004) indicates that in Cuba, EV is used as a major technology in teaching and learning in schools; all subjects from primary to high school are taught with the assistance of technology, and video plays a big role in the process.

Specifically, this study intends to understand whether the use of EV in the two secondary schools in KwaZulu-Natal Province in South Africa can help improve learners' performance in mathematics. Walsh (2007) argues that EV stimulates learners' imagination, develops their critical thinking skills, and helps students get a feel of what happened in the setting. Walsh (2007) notes in particular that the moving images convey body language and facial expressions. This hint of atmosphere helps different learners with different learning styles – such as visual learners, audio learners, or kinesthetic learners – to make sense of the concept being taught. EV has gained wide recognition and where it is used it has significantly shown positive results in improving students' capability and capacity for improved content absorption, as attested by Alexander, Higginson and Moge, (1999). From the researcher's experience as an educator, some teachers seem, however, to use EV more for leisure purposes than as a systematic teaching aid, and this does not seem to benefit learners.

Felder (1988) argues that learners have different styles of learning and that an individual learner's intellectual development grows differently from others. Some

learners derive meaning through visual-audio stimuli, while others respond more to kinesthetic stimuli. Felder insists that there is a need to vary the learning styles to cater for differences and uniqueness in learners. EV is a resource that helps students in their diverse learning styles and in the acquisition of knowledge, making it a vehicle for delivering quality teaching and learning (Alexander et al, 1999). The researcher intends to find out how educators and learners in the two secondary schools in Durban use EV to improve mathematics content acquisition.

### **1.3 Focus and Purpose of the study**

The focus of the study was to understand the utilization of educational video to facilitate learning of mathematics in two secondary schools in Durban, KwaZulu-Natal Province. This study was intended to explore educators' perceptions and the challenges they encounter in integrating EV in the classroom, as well as how they cope with their daily interaction with learners and in the transmission of information in the classroom and around the globe through the use of EV.

### **1.4 The problem Statement**

Despite the efforts of both educators and learners in the teaching and learning of mathematics in South African schools, matric results indicate low performance in the subject (Kahn, 2004; Lubisi and Cronje 2007). On the other hand, literature has indicated the usefulness of EV in classroom instruction in other countries: how it has successfully enhanced the teaching and learning of mathematics globally (Walsh, 2007; Gutierrez, 2004). It is within this context that government has mandated all schools in South Africa to have integrated technology in teaching and learning by the year 2013. The draft white paper on e-Education (2003) indicates that the world is changing and technology is central to this change, and that digital media have revolutionised the information society. These advances in technology have dramatically transformed the learning and teaching process and expanded new learning opportunities and access to educational resources beyond those traditionally available.

This White Paper on e-Education sets out government's response to a new information and communications technology environment in education. It is imperative that schools use technology to provide learning environments that advance creativity, communication, collaboration and engagement (Draft white paper on e-education, 2003). It is therefore important that an investigation, such as the present study, be undertaken into the approaches that will best cater for learners' needs within the prevailing problem of mathematics content acquisition. This will provide suggestions which, if appropriately implemented, will inform educators on the diverse approaches that could be used to enhance the teaching of mathematics in the country.

### **1.5 The Significance of the Study**

The study aims to provide teacher educators with the material that can be consulted, especially at the selected schools. The researcher's intention is to provide the two schools with copies of the research findings which they can consult so that they can improve their approaches to the teaching and learning of mathematics, with a particular focus on development of skills in using educational video for this purpose. Since there is not enough literature in South Africa on the use of video in teaching mathematics, the present study will, it is hoped, be a useful addition to the literature.

Because the sampling in the study was limited in scale the findings cannot be over-generalized, but they will nevertheless be transferable to similar situations.

Unlike other technology such as computers, where each learner needs to have access to an individual machine, video is economical. A video cassette, if it is taken care of, can be watched by each learner in the class in his or her own time. Learners can loan videos and be able to use them both at school and home. Computers, on the other hand are expensive and schools cannot provide for every learner. The majority of learners in South African schools share computers at schools. With video, however each individual learner is able to access information without any inconvenience that might be caused by the number of learners in the class and or a shortage of materials. The present study thus hopes to benefit both educators and learners to effectively utilize EV to enhance teaching and learning which will enable learners to perform highly in mathematics.

The study also hopes to benefit teacher educators in equipping them with skills in the use of technology in teaching to improve classroom instruction, particularly in the teaching and learning of mathematics, as mandated by the government through the draft White Paper (Pandor, 2003).

This study should, furthermore, add value to the literature on the use of educational video in the teaching and learning of mathematics. The use of video in teaching and learning is not as well established in the two South African schools as it is in other schools in developing countries such as Cuba (Gutierrez, 2004) and in developed countries such as the United States (Crean, 2001), where it is firmly established in both in schools and tertiary education institutions.

The investigation in this study of the educators' perceptions on use of EV in their classrooms will in turn help teacher educators to enable and motivate trainee teachers to integrate technology in their teaching. Furthermore educators at large who are interested in integrating video in their schools and universities will benefit from this report, which will give them insight and guidance to improve their style of instruction and their approaches to the teaching of mathematics.

## **1.6 Review of Related Literature**

The researcher systematically examined the empirical studies on educational video from both international and local contexts in order to investigate how people understand the use of EV, looking at their methodologies and research findings to establish whether they were related to the researcher's study. This has helped the researcher in this context to share commentary on gaps that exist and this study will be of assistance to educational institutions and other future research.

Studies from developed countries provide a considerable amount of relevant material. In the USA, for example, Galvis, Rose and Gadzuk (2003) conducted a study on "how much teachers use video in teaching." Their findings indicate that in the United States, on average, a period of six hours per week is spent on video use in teaching and learning. Alexander et al (1999) conducted a similar case study on the use of video in the teaching of mathematics. Findings also reflect that as a tool to assist in delivering quality teaching and learning video opens possibilities for collaborative

teaching and learning. Learners from different countries, for example, are able to share skills and experiences. Video gives access to expertise not available within the school. Research findings from the study conducted by Hiebert, Gallimore, Garnier, Givrin, Hollingsworth, Jacobs, Miu-ying Chui, (2003) on “Teaching of Mathematics in seven countries”, shows that EV helps both educators and learners to improve teaching and learning of mathematics. The findings also show that using EV assists educators to improve their teaching of mathematics by observing how other educators from other countries approach the same topic. This enables them to make teaching practices more visible and therefore more open for reflection and improvement, hence upgrading content acquisition by learners.

### **1.7 Theoretical framework**

The study was guided by the interpretive paradigm in understanding how educators perceive the use of EV, and observed how educators used EV to facilitate learning. Henning (2004) argues that in the interpretive paradigm, knowledge is constructed not only by observable phenomena but also by descriptions of people’s intentions, values and reasons, meaning-making, and self-understanding. It is for this reason that interviews and observations were used to understand how educators and learners understood, perceived and used EV to enhance an understanding of mathematics.

Hiebert et al (2003) assert that qualitative researchers operate under different epistemological assumptions from quantitative researchers. They also argue that the best way to understand a phenomenon is to view it in its context. Qualitative researchers posit that there are multiple realities constructed by human beings who experience a phenomenon of interest. In this study, the reality about the use of EV in the classroom to facilitate learning in mathematics unfolded when people shared their own experiences through observations and interviews.

The Engagement Theory of Kearsley and Shneiderman (1999) was used. Its major premise is that for effective learning to occur, students must be engaged in their course work through collaboration with other peers, project involvement, and being authentic. Kearsley and Shneiderman make the point that in order for effective learning to occur, learning should be creative, meaningful and authentic. Engagement

Theory helped the researcher to find out how learners engaged meaningfully and authentically in the course work using EV.

Activity Theory was also used which, according to Kuutti (1996), focuses on the interaction of human activity and consciousness within its relevant environmental context. This theory helped the researcher to understand and to discover the hierarchical structure of activities which learners were engaged in to develop and transform their way of learning as a result of EV usage in the lesson.

The principles of these theories in relation to engagement and activity were used to form a new theoretical model for analysing the data in this study.

### **1.8 Key research questions**

- How do educators and learners currently utilize EV in the teaching and learning of Mathematics?
- What are the perceptions of educators on the use of EV in the teaching and learning of Mathematics?
- What challenges are faced by educators in using Educational Video in Mathematics education?

### **1.9 Methodology**

Henning (2004) asserts that qualitative research means the kind of approach that produces findings arrived at from real-world settings where the phenomenon of interest unfolds naturally. A qualitative case study was adopted in the present research. Yin (1994) and Zonabend (1992) assert that case studies are records of innovative or good practice. They record specific problems or issues experienced by people or groups. This approach was found to be appropriate for this research. This is because the researcher went to the setting to observe how educators and learners used video in teaching and learning as well as to interview both educators and learners in order to understand their perceptions on the matter. In this case study, the researcher interviewed both educators and learners from the two selected schools. She observed mathematics lessons and reviewed documents such as test records, learners' work

books, and progress reports. Learners' interviews, classroom observation and documents were used to confirm data from educators' interviews.

### **1.10 Data analysis**

Henning (2004) recommends that qualitative data be analyzed right from the beginning of the data collection process, with the researcher constantly reflecting on impressions, relationships and connections as he/she continues with the process of collection, dividing, categorizing, and grouping of data into smaller and more meaningful units. The intention is to understand and explore the utilization, perceptions, and challenges encountered in the integration of EV in teaching and learning mathematics. The guided approach will be used to analyse data, based on the adoption of concepts from both Engagement and Activity theories. This has helped the researcher to interact with the principles of the two theories in order to interpret and analyse data in this study by formulating themes and suitable categories to facilitate the discussion of the data collected.

Observations and document review will be discussed using the themes. It is in this context that the data will be presented and illustrated by visual means such as pie charts, graphs, bar graphs, and tables (See chapter five).

### **1.11 Trustworthiness of the research**

Validity and reliability in qualitative research are based on the honesty, depth, richness, trustworthiness and quality of the study. Since the researcher used the interpretive paradigm, the major aim was to understand ways in which educators and learners make sense of the context in which they work. The qualities of the results were judged on the ground that they were believable from the perspective of the participants in the research. Terreblanche and Durrheim (2002) assert that the credibility of the study is established during the research. The researcher looked for evidence in the practices developed as a way of producing a rich and credible account. Triangulation and crystallizing methods of collecting data were also used, which in this case were observations, interviews, and documents that included test records, learner's work books, time tables and progress reports.

### **1.12 Ethical Issues**

The study participants were given an informed consent form explaining clearly what the study was about, as well as their role. This was done in order to avoid deception (Cohen, Manion and Morrison, 2000). Goddard and Melville (2004) believe that collecting data from people raises ethical concerns. Mitchell and Jolly (2004) emphasize the need for ethical issues and discourage any study that is not conducted ethically. Harming people physically, emotionally and psychologically was avoided, this was done in two ways, by communication and by giving concern forms to the participants which indicated the purpose of the study, ensuring that their participation is voluntary and they are at liberty to withdraw from the study at any time for any reason (see Appendix F). The right to privacy furthermore was not violated meaning that their anonymity was honoured, as indicated by Cohen, Manion and Morrison, (2000). Anonymity and confidentiality of names and information given was also assured. Participants were assured of voluntary participation, and that they were free to withdraw from the study at any time for any reason, and that their withdrawal from the study would not bring them any harm.

### **1.13 Limitations to the study**

In the context of this study the effectiveness of both teaching and learning is measured by means of observation. This is one of the strategies used to determine the improvement of performance (Wergin, 1992). Measuring performance is subjective to the observer and, as such, the improvement brought about as a result of the integration of EV in teaching and learning of mathematics is subjective, in the sense that those educators who do not want to change their approaches to teaching may have a different opinion from those that use it and appreciate its impact on the learners' performance. Lack of exposure of educators in the use of EV in teaching affected their competence, hence poor facilitation of mathematics concepts. As a result of these dynamics educators develop technophobia, the fear of handling technological equipment.

On a number of occasions the interviewees were not available for interviewing purposes. In some cases they were committed to other duties and in other cases there would be lack of interest or the fear of judgment from the researcher. This delayed the

process in that the researcher had to keep on asking them. This affected the time scheduled for each interview session.

Case studies are descriptive methods, and not explanatory, as per Yin (1984). In other words, without the controlled conditions of the laboratory, conclusions about cause-and-effect relationships cannot be drawn. Behaviour can only be described, not explained. These types of studies, furthermore, involve only a single individual or just a few, and therefore may not be representative of the general group or population.

In the social sciences, case studies often rely on descriptive information provided by different people. This leaves room for important details to be left out. Moreover, much of the information collected is recollections of past events, and is therefore subject to the problems inherent to memory (Yin 1994).

#### **1.14 The Structure of the Study**

This chapter has described the problem of the research, intended research design and methodology to be followed.

Chapter Two reviews literature around technology and educational video technology in the teaching and learning of mathematics. It also presents the impact of the technology on the teaching and on the performance of learners. Chapter Three summarizes the theoretical framework of the study. Chapter Four describes in detail the research design and methodology used in this research. The analysis and discussion of the findings are presented in Chapter Five. Finally chapter Six summarizes the findings and makes recommendations.

#### **1.15 Conclusion**

Chapter one serves as the introduction to the whole study and gives an overview of the study, which is on the use of educational video to facilitate the learning of mathematics in the two secondary schools in Durban, KwaZulu-Natal Province, South Africa. The structure of the whole study is outlined in this chapter. In the next chapter, the researcher will address the views of scholars on the use of video in teaching and learning, as presented in literature.

## CHAPTER TWO: Literature Review

### 2.1 Introduction

This chapter discusses existing research findings that have significance for the present study. The chapter focuses on the advantages of video in teaching and learning mathematics, barriers to its use, and the perceptions of educators towards using it. In addition the chapter reviews various related learning theories.

Walter (1998) writes that learning is the acquisition of knowledge, which is a result of experience. He further argues that knowledge cannot be received passively. Instead, it has to be actively discovered and should awaken the curiosity, stimulate creativity, develop proper interest, attitudes and values, and build essential skills such as independent study and capacity to think and judge for oneself. In the experience of the present researcher as an educator, it is, however, often the case that learners are observably *not* being engaged in challenging learning experiences: instead, they sit in well-managed classrooms listening to their educators who are considered to be the only ones knowledgeable about the subject content. Educators such as these rely simply on the lecturing approach, which Ellington, Percival and Race (1993) characterise as being inevitably dependent on the skills and ability of an individual educator to organize and explain a topic. And with some educators being clearly more knowledgeable than others, there will in consequence be significant inconsistency in the teaching and learning of mathematics. The authors recommend that lecturing should not be used alone; where it can be effective is when it is used in conjunction with a suitable combination of supportive and complementary teaching methods. Similarly, Krupka and Tishby (2007) note that in view of the complex interaction between the multiple facets of teaching and the diversity of learning styles it difficult to propose hypotheses or draw conclusions about the specific features of teaching that most influence students to learn. They conclude that diverse configurations of features need to be adopted in order to present clear formulations to the learners. Hiebert and Wearne (1993) suggest that the involvement and engagement of the learners in their learning using different methods and tools might have greater influence in the teaching and learning process.

The work of Marshall (2002) on the other hand was concerned with a variety of learning-theory studies investigating why using multimedia technology to represent information is so affective in teaching and learning. Marshall discusses various theories of learning that help explain the effectiveness of video and multimedia in teaching and learning. One of these is “arousal theory”, which is based on the idea that different individuals perform better at different levels of arousal (and hence of stimulation), and that every individual seeks to find his/her optimum levels. This theory is supported by the Yerkes-Dodson Law, namely that arousal contributes to increase performance up to a certain point or level. A second theory is “short-term gratification theory”, which explains why mass media have their effect and the types of gratification the media generate. This theory relies on the belief that the audience is not merely a group of passive media consumers; rather, in their reaction to mass media they play an active role in selecting different media to meet their needs. A third theory, “interest-stimulation theory”, proposes that technology can enhance learning by stimulating learners’ interest, and thereby creating a thirst for further information. For example, once having viewed a program on a given topic, learners will be more likely to display increased interest in the classroom and be eager to have another chance of viewing the next one. Implicit in this theory is the notion that interest leads to action. South African learners are not an exception. Like other learners, they can be motivated by the use of technology to achieve the set goals.

## **2.2 Technology in teaching and learning**

The earliest use of film in teaching, which was in cultural and educational studies, was in the 1930s. Video recording was a later arrival on the scene and was used in teaching and learning once technological development made it practical to do so (Knipe & Lee 2002). Significant and effective introduction of technology in teaching and learning dates from the 1950s. Walter (1998) writes that technology has got to the stage where it makes education more widely available and improves the quality of education already available. His argument is that successful learners achieve through involvement and engagement in their learning process; technology helps in increasing the quality of learning and the degree of mastery, because it encourages learners’ engagement in learning activities. It also helps to shorten the time taken for learners to attain the desired goals, increases efficiency of teachers in terms of numbers of

learners taught without reducing the quality of learners, and promotes independence of learners. This helps learners to be totally involved and engaged, hence responsible for their own learning (Ellington, Percival & Race 1993). Technology would be useful in the South African classrooms which have high enrolments in that it will improve the quality of education by increasing the efficiency of educators to be able to cater for the large numbers of learners in classrooms

“Multiple intelligences theory” as developed by Gardener (1983) proposes eight types of intelligence. Gardener describes this as an array of different kinds of intelligences exhibited by human beings. Each person has a unique cognitive profile. The theory furthermore addresses the ability of entertaining media to engage learners, activate emotional states, initiate a topic, and allow for absorption and processing of information.

Gardener’s theory (in which one of the eight intelligences is “Logical-Mathematics Intelligence”) advocates that teachers be trained to present their lessons in a wide variety of ways using multimedia. He describes his theory as having grabbed the attention of many teachers around the world, with schools in the United States currently using its philosophy to redesign the way they educate learners (Gardener, 1983). Multisita (2001) shares this view and points out that ordinary ways of learning mathematics have been found to be in crisis. It is for this reason that a possible solution could be the use of technology, for it provides motivation, experimental learning through the involvement of learners in project based learning, world problem-solving, and collaboration of teachers and learners, all sharing the same interests.

Lubisi and Cronje (2007) comment that if Gardener’s suggestions were effectively adopted it would rescue both educators and learners from the crisis of deteriorating performance in mathematics in South Africa.

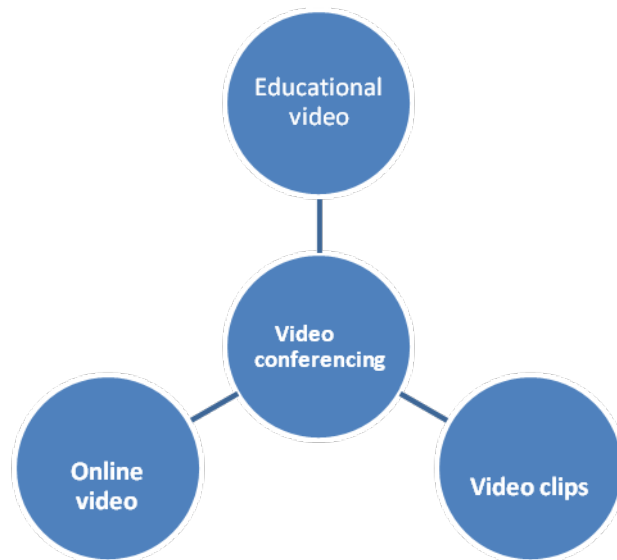
Brophy (2004) moved from general discussion of what may impact on the way learners learn (which Hiebert and Wearne (1993) are researching) to the specific use of technology and its contribution in teaching and learning. Bames and Brandon (1997) assert that the use of technology and multimedia improves instruction. They undertook a comparative study in which one group of students were learning with the aid of technology and a control group learned without the use of technology. The

findings indicate that the group of students which used technology in learning outperformed the non-technology learners on tests, scoring higher in their assignments, applying more varied methods, using creative approaches to problem solving and also being active in classroom discussions. In the South African context, the use of multimedia could accordingly be considered apposite because learners are used to watching videos at their homes for other purposes’– from which it can be assumed that watching video material in a classroom in learning mathematics will be normal and interesting.

On the other hand, Knipe and Lee (2002) conducted a study which indicates that video is not an effective tool for teaching and learning mathematics. The results of their study indicate that out of 66 masters’ students, 45 were local students who had a chance to review information and explanation from the lectures to read and review materials, to work in groups, and to make presentations. These students were more successful than 21 rural students who used only video to learn. Findings show that the quality of teaching and learning may be poorer than in a traditional method. This can happen in our schools in South Africa too. If learners are simply left alone with video without guidance from the educators, learning will be poorer as the video fails to perform the role of educators; learners need to be facilitated and guided so that they meet expectations. Video as a tool for learning should not be expected to perform the educator’s role.

### **2.3 What is Educational Video?**

Video is one of the audio-visual aids which Starkweather (1995) characterises as appealing to the sense of hearing and vision when used in classroom for presentation of abstract information. Audio-visual aids may be used to convey meaning without complete dependence on verbal symbols or language. Researchers and authors give various names to video usage according to the contexts of use. To avoid ambiguity, the researcher uses the term “educational video” (EV) to cover video employed in teaching and learning: if the video is used mainly for teaching and learning, then the programs are educational. The following diagram shows the terminology given to various kinds of video use according to the context.



**Figure 1: A researcher’s model indicating names given to various usages of video**

### **2.3.1 Video conferencing**

Acker and McCain (1993) describe video conferencing as an interactive telecommunication technology which allows two or more locations to interact via two-way video and audio transmissions simultaneously. It provides students with the opportunity to learn by participating in a two-way communication platform. Furthermore, teachers and lecturers from all over the world can be brought to classes from remote places. Learners from diverse communities and backgrounds can come together to learn about one another because they are able to explore, communicate, analyze and share information and ideas with one another. Through video conferencing, students can also visit another part of the world to speak with others and learn from them (Acker & McCain, 1993).

### **2.3.2 Online video**

Online video is video material accessible on the internet. This is a resource for Net-generation learners who have been surrounded by digital media since they took their first breaths. These videos enable learners to improve retention and test scores in different subject areas (Acker & McCain, 1993).

### **2.3.3 Video clips**

Video clips are short extracts of video, usually a part of a longer piece, selected to present a specific part of the lesson. They might be used, for an example, if the educator intends to present the introduction of the lesson only and teach the rest of the lesson later. An individual learner can access a library of video clips relevant to his or her curriculum on the Net (Acker & McCain, (1993).

## **2.4 Video in the Teaching and Learning of mathematics**

According to Felder (1988), technology affects people's style of living and also the way they learn. Learners really enjoy watching movies and video for a variety of reasons. Their interest in watching home video films can be exploited in formal school systems in teaching mathematics practices in a vivid and entertaining way. EV provides common ground for learners of any international background and seems to have the potential to engage even the most indolent students.

Learners' performance in mathematics has been a constant subject of discussion for many years. Researchers indicate that learners perform relatively poorly and significantly lower than the expected mean. The reason for this, according to Ellington, Percival & Race (1993), has been that educators differ in their interests and capabilities, and in the approaches they use in teaching mathematics in their different classes. These authors argue that the solution to this problem lies in the use of multimedia approach in mathematics teaching and learning.

According to Acker and McCain (1993), video is a tool which can assist in delivering quality teaching and learning because its moving images help to capture learners' attention and focus. It opens up possibilities for collaborative teaching and learning in that learners are given a chance to participate in the discussion with other learners in the classroom and outside the classroom. Similarly, Kellogg and Kersaint (2004) conclude that EV can provide "live" support for learners, especially during holidays and while at home doing their assignments and projects. It provides learners with opportunities to work with their peers from other institutions and countries. In other words, video enables and supports collaboration among colleagues in their group work and international projects. It also serves as a medium for interaction between educators and learners during the process of teaching and learning.

Kellogg and Kersaint (2004) write that with the use of educational video learners retain more information and understand concepts more rapidly and are more enthusiastic about what they are learning. It also enables learners to discover links between the given topics and the world outside the classroom. With video used as a tool in a thoughtful and well organized lesson plan, learners make new connections between curriculum topics and data analysis. These authors observe that video is a teaching tool with potential to stimulate imagination, and, as such, offers different perspectives or approaches to a topic. Video connects learners with faraway places, demonstrates abstract ideas, provides a common experience for all learners no matter the location, equalizes educational opportunities and promotes critical viewing skills and awareness.

Dewey (2002) conducted a study focussed on grade eight mathematics teachers in the United States. The purpose of the study was to assess how best to improve everyday teaching and learning of mathematics in grade eight. The findings signify that the use of video in teaching and learning of mathematics helps both teachers and learners to improve in teaching and learning of mathematics concepts. Kellogg and Kersaint (2004) argue that the integration of video in teaching and learning can benefit educators in both developed and developing countries. This suggests that the use of video could also work for South African schools in improving the approaches of both educators and learners to mathematics instruction.

Steffen (1998) writes that it is common among educators to bring a variety of educational and professional experiences to classes they teach, and these experiences influence their planning and implementation of lessons as well as their expectations of the learner's understanding and acquisition of knowledge. This has revealed imbalances in teaching and learning, especially because some teachers are more qualified and knowledgeable in mathematics than others. Steffen concludes that these imbalances can be resolved by the use of video in teaching and learning in opening up the possibility of sharing ideas and approaches from other educators around the world. In the same way, Kellogg and Kersaint (2004) recommend the use of video as an instructional medium that generates interest and seems to be perfect for all types of learning style, such as for both auditory and visual learners. It taps the emotions which stimulate and enthrall learners and provides an innovative and effective means for educators to address the curricular concepts. Felder (1988) shows that the more

learners are engaged in their learning, the more interactive and enjoyable lessons become; hence learning and retaining of information results. Ellington, Percival and Race (1993) cite video as the most useful audiovisual aid available for modern educators, going on to note that video has made a considerable impact on instructional methodology and that its benefits are potentially twofold; it stimulates learners' new interest, and it allows them to develop even more interests which usually sustain them throughout the lesson.

Brophy (2004) conducted a case study on the feasibility and effectiveness of various types of uses of video in education. The findings indicate that it is accepted as a very powerful medium in learning experience and is widely accessed. Ball and Cohen (1999) have documented that the use of video provides a means by which teachers can have access to teaching that would otherwise be difficult to observe in real life. In other words, the use of video enables educators and learners to teach and learn abstract concepts in mathematics. The use of video would benefit South African learners by giving them access to the explanation and presentation of non-figurative concepts. It is difficult and demotivating to learn something that one has never seen, and video can provide a picture of something the learner would not otherwise have access to. The integration of EV will make it possible to observe and see demonstrations of abstract concepts.

#### **2.4.1 Using Video in Higher Education**

The use of video in teaching and learning benefits mathematics learners not just in schools but also at the level of higher education.

Gage, Nickson and Beardon (2002) were involved in a project aimed at using video to contribute to the enrichment of mathematics in schools and to give students an idea of how practicing mathematicians use mathematics in their working lives. The findings showed that video conferencing provides students with a real audience for presentations and gives them an experience of collaborative work. With the use of video, students were able to complete the preliminary tasks of their course on time. They were actively involved in activities and discussions, and were fully engaged in mathematical activities. Findings further indicate that the trainers valued the use of video in training, arguing that it provides their students with the opportunity to work independently. There was collaboration between students as they worked on problems

beyond the normal curriculum. Their presentations were also improved, and the trainees valued the variety that video brought into the mathematics teaching and learning. They also had a chance to communicate with other students from other institutions by giving presentations and discussing problems in mathematics. As pointed out earlier, the use of video in South African schools will be appropriate because learners can learn a lot from other learners outside the classroom.

The work of Hatfield and Bitter (1994) and Gutierrez (2004) focused on the use of video to train new teachers. Video was observed to provide trainees with the ability to have more control over the information and empowers them to set their own pace in the learning process. This can work in South African schools in that it is possible for each individual learner to review the video as many times as needed. Each learner's pace can also be accommodated in the video-integrated classrooms.

While these views are appealing, other studies have shown that although video is widely used in higher education for the delivery of lectures there is concern that if teachers are not careful enough the quality of teaching and learning in those institutions may be poorer than that experienced in a traditional approach. This present case study explores the use of EV in the schools where educators are expected to apply techniques to help learners achieve the objective. The expectation is that learners will be guided and facilitated at all times and not just left on their own. The findings of the comparative study conducted by Knipe and Lee (2002) indicate that educators need to have a clear plan on what they want their students to learn from the videotaped lessons. Not every video will be appropriate for learners, and so educators need to find the appropriate video material for the specific topic.

#### **2.4.2 The Use of Video in Different Teaching and Learning Situations**

The use of video has been observed to be successful not only in the ordinary classroom situation where all the learners are able to learn in a normal way but also in situations that are problematic because of compromised learning capability and barriers like language, social skills, and culture, along with the case of learners with special educational needs. Hiebert et al (2003), for example, conducted comparative evaluations of teaching by video conferencing set against conventional methods to investigate how video conferencing can support students' collaboration across language barriers in developing communication and social skills amongst learners

with special educational needs, extending multicultural understanding between students of different backgrounds and providing students and teachers with improved peer support. The findings point out that, with the use of video, learners find a support which was the outcome of a detailed process of collaboration between professionals. Similarly, the study observed the positive impact and support the video provides in collaboration between learners who have different experiences and backgrounds. This current study intended to find out if the teaching and learning using video can enable learners from the two selected schools in KZN to acquire the skills of dealing with mathematics problems and assimilate mathematics concepts in spite of the barriers of their learning abilities, differing cultures and backgrounds.

Educational video assists learners in improving their assimilation of mathematics: No Child Left Behind (NCLB) (2001) asserts that the use of video as an instructional tool in the classroom improves learning. NCLB (2001) undertook a study that demonstrated a link between the uses of video as a teaching tool and how it improves learning. Findings based on evidence from teachers show that the use of video in the classroom improves learning and retention, and therefore improve test scores.

#### **2.4.3 Video in Teaching and Learning Mathematics in South Africa**

Steffens (1998) asserts that learners from rural areas in South Africa seem to have a particular difficulty with learning statistics, and also with mathematics concepts and notation. According to Stiffens, the solution could lie in the adoption of new approach which uses technology to teach, especially in introductory courses, where he sees the introduction of video and other multimedia as a revolution that is beginning to take place in the field of statistics teaching. He argues that video gives learners an opportunity to work independently and collaboratively in that they are enabled to discuss problems in mathematics with other learners and work together in finding solutions. He concludes by recommending video as a tool that can be used in different teaching and learning situations. The researcher in the present study wanted to explore whether the use of video in teaching and learning can positively encourage the assimilation of mathematics knowledge of learners from two KwaZulu-Natal secondary schools, one in a township area and the other in a rural area, to assess in particular what potential influence it has on rural South African learners' performance in mathematics..

A study by Malloy, Meece and Hamm (2006), conducted over a three-year period, focused on examining the ways in which 'Mathematics reform Instruction' influenced by the use of multimedia shapes students' development as mathematics *knowers* and *learners* during the middle-grades years. Their findings document changes of development in students' learning and self-conceptions in middle-grades mathematics classrooms. Malloy, Meece and Hamm encourage the use of video in teaching and learning of mathematics,

### **2.5 How Educators and Learners Utilize EV in teaching and learning mathematics**

Gutierrez (2004) reports that in Cuba EV is comprehensively used as an instructional tool in all areas of learning, not just mathematics: every classroom in Cuba (even in the smallest school) has a monitor, enabling educators and learners to use video especially in the teaching of abstract concepts. Learners' parents, too, are encouraged to be present during classroom video presentation to empower them to give further support to their children's video learning. Confirming the importance of in Cuba of EV in teaching and learning Gutierrez cites a Cuban saying that when learners do not want to come to school they break and disconnect the videos.

Lindstrom (1994) writes that a high percentage of communication is through non-verbal cues (facial expressions), which means that seeing the person making a presentation can give learners much more information. Non-verbal and facial expressions enable learners to capture more information and to interpret additional messages not explicitly articulated by the presenter. Video also offers visual aids which speed up the process of explaining certain types of information. This is observed by the saying that is sometimes made by learners like; "I realized that I never truly noticed any of Maggy's or Ed's effect or non-verbal cues when I previously viewed the presentation. However, when I watched it for a second time, I noticed many interactions that I had not before". Video also has the unique advantage of there being no limit on the number of times that learners can view a repeat of the presentation. South African learners, like other students around the world, also need the added understanding and interpretation transmitted by the non-verbal cues.

### **2.5.1 How is Video Presently Utilized in Other Classrooms**

Dewey (2002) writes that video is an enriching and enhancing resource for classroom teaching and learning. It is focused and because of this helps to clarify concepts. Dewey advises that for deriving fullest benefit from video educators should have a clear strategy in the way they use it, integrating it into the overall learning experience by framing lessons with experiential components. Viewing videotape segments should be preceded by activities to set the stage, provide background and information, identify new symbols, or to introduce the topic. After the viewing, follow-up activity should be done to reinforce, apply, review, or extend the information conveyed by the program. According to Dewey (2002), these strategies will help both educators and learners to benefit from the use of video. Dewey encourages educators to consider three steps in the teaching and learning mathematics using video: (a) focus for viewing activities (pre-viewing) (b) viewing activities and (c) post-viewing activities, all of which are relevant, too, in the South African context.

### **2.5.2 Focus for viewing**

*Engage learners' viewing attention by having them watch for specific information:*

In using instructional video material educators should engage students' viewing attention by having them watch for specific information. This means that educators should tell learners clearly at the beginning of the lesson what they expect them to learn so that learners watch the video already having in focus the desired outcomes of the lesson. Therefore, the choice of video segment specifically for the selected topic is important in this juncture.

*Give learners a task to be completed during or after the video show:*

Educators should give learners a task to be completed during or after the video segment is shown. Showing brief clips of the video has an advantage of enabling the learners to concentrate on the specific information only, knowing that the segment contains all the content for the given task so the correct completion of the task ensures the acquisition of concepts.

### *Viewing activities:*

Dewey (2002) encourages segmenting the viewing of the program because this makes it possible for educators to stop and ask learners questions to stimulate on-the-spot discussion, and check whether learners still follow. Viewing tasks are completed during viewing sessions and educators make sure that learners complete the task successfully. Lights in the classroom may be left on and educators may consider showing the video without sound, to narrate the program, or ask the learners to do so. To enhance the strategy of video teaching, educators sometimes darken the screen and use only the audio component. They also discuss the program after the show to clarify the identified ambiguities.

### *Post-viewing activities:*

At the end of the show, teachers and learners have a discussion on the lesson. Both educators and learners share their understanding on the lesson. This helps them to recognize the diverse responses and reactions of different learners. Corrections to misunderstandings are to be done on the spot. Learners relate the program to their own understanding and experiences. Educators connect and extend activities like long-term projects where learners would be involved in the authentic learning and in group work in which they research, communicate, and collaborate with colleagues as they work on their tasks (Dewey (2002)).

## **2.6 Video Use in Instructional Situations**

Ellington, Percival and Race (1993) suggest different ways in which educators and learners utilize video in teaching and learning mathematics: while some use it in mass instruction, others use it in individualized and group learning. The use of video, according to Ellington, Percival and Race, has high impact and, through it, learning experiences are enhanced.

Video can be used in virtually any type of instructional situation, either to provide illustrative or supportive materials, or as the vehicle by which an exposition or instructional sequence is presented. Video can also be used for presenting visual material of all types that include charts, illustration, diagram and images (especially for abstract concepts).

Video can be used to introduce a lesson or concept, meaning that it can be used as an introductory part of the lesson. It can help reinforce previously learned content and in the process, enable learners to review the learned materials as a revision or to help extend the content. This is done by allowing learners to watch video presentation for revision at their own time and favourable time, guided by educators or by parents if it is at home.

### **2.6.1 Video Use in Mass Instruction**

Video can be used as an instructional tool in presentations to a large number of learners, such as in lecture rooms, either by using projection facilities that allow a very large image to be projected onto a central screen or by having television monitors at various points in the room so that people can see the screen from wherever they happen to be seated in the venue.

Sfard and McClain (2002) discuss the potential that video has to provide illustrative background or supportive materials within the context of conventional lectures or demonstrations. It is suitable where motion needs to be demonstrated or where elements of the world outside need to be brought into the teaching and learning situation, such as in the teaching of probability where the situation has to be displayed on the screen for learners to observe.

The authors give the example of having a video that shows cars passing in front of a given location (“Ralph's supermarket”) with learners being asked to find the probability of more white cars than brown cars passing the location between 5:30 p.m. and 6:00 p.m. Video put the learners in a position to find the answer because it brings the scenario into the class for them to watch. EV provides self-contained expositions that takes the place of a conventional lecture or taught lesson on a given topic. Video can be used as a vehicle enabling learners to interact and collaborate with other learners in and outside the classroom (Sfard & McClain 2002).

### **2.6.2 Video Use in Individual Learning**

Learning objectives and content preferences do not necessarily coincide. While one learner may wish to take an advantage of the amount of content for the allowed time, another may look for the most pleasant way of doing it. One learner may also want to study the given content in depth, while another may want to study the same content to

evaluate the coverage of the course. The cognitive differences in individual learners are caused by diverse circumstances.

The following table summarizes the requisites for individual learning and the conditions for their achievement:

**Table 1: Requisites and conditions for individual learning**

(adapted from Sfard and McClain 2002)

<b>Requisites</b>	<b>Conditions for their achievement</b>
Perception of a need	Motivation External stimuli Synchronisation Time
Identification of an object that matches the need (objective).	Self-confidence and confidence in others Interaction with others Collection, analysis and communication of information Enterprise
Identification of a strategy for reaching the objective.	Behavioural attitudes: flexibility, self-regulation, social regulations Problem-solving abilities: observation, generalising, discovering, making hypotheses, correcting, analyzing, comparison Psychological attitude

Individual students differ from one another in various ways. They differ in cognitive intelligence, creativity, learning style, pace of learning, concentration dependence or independence. They also differ in personality: in self concept, locus of control, level of aspiration and performance motivation. When considering these learners, it is important to remember that learners come from different backgrounds, that they need

flexible interaction with resources facilitating the construction and elaboration of their learning strategies, and that they also need to acquire an overall learning experience and develop learning abilities and qualities necessary for effective autonomous learning. The role of educators is to create an environment for successful learning and to assist learners through discussion and recommendations, and to motivate and inspire them in the process. To cater for these differences, Dewey (2002) argues that the use of video in the classroom is essential.

To meet the requirement of individual learning, Ellington, Parcival and Race (1993) suggest that learners should be provided with video recordings as key parts of learning packages. As this encourages learners to control over the pace and manner in which they learn, learning packages are accessed in the way that is most suitable to each individual learner. Individuals will be able to stop and start the sequence at will, or replay parts if this is found necessary or useful. They can be watched wherever the learners choose to watch them and at any time that suits them. Video can also be supplied to learners by mail or loan.

### **2.6.3 Group Learning**

Video materials can be used by groups as a way of facilitating the interaction of members of group in role-playing simulations and microteaching. Interactive video packages will allow group discussion and planning and provide immediate responses. Small-group interaction helps learners promote cooperation and collaboration in the classroom, providing much-needed opportunities for both peer interaction and heightened achievement. This approach seems to be particularly appropriate with young adolescents because this is a stage where there is a preference for activities and interaction with peers during learning activities, with potential for development of high-level thinking (Ellington, Percival & Race, 1993). This can work with South African learners because most of grade ten learners are adolescents – for whom working in groups and interacting with other learners adds motivation.

## **2.7 Perceptions of Educators and Learners on the use of Educational Video**

### **2.7.1 Educators' Perceptions**

According to Dewey (2002), if educators teach like they taught yesterday, they rob their learners of tomorrow. In other words, teaching and learning without recourse to technology limits the exposure of learners to the approach that enables them to access information from other sources. Dewey (2002) emphasises that video prepares learners to harness the power of technology and use it as a tool to learn effectively. According to Dewey (2002), educators were initially reluctant to use video in teaching but after training their attitude changed, and he notes in his paper that thousands of educators under NTTI use the video in their classes – adopting the motto that says technology has come “as a way to plug their learners into appropriate use of technology so that they are plugged from their futures” (Dewey, 2002 p.47). This might be the case with some educators in South Africa; they may be reluctant to accept changes, but stick to the traditional way of teaching.

Felder (2003) writes that after the introduction of video into the teaching and learning of mathematics, educators commented that video enables learners to explore basic topics in high school mathematics in ways that cannot be done at the chalkboard or in a textbook. This means learners were able to watch concepts being demonstrated on the screen, in contrast to the lecture method where, in trying to understand what is presented to them, learners have to try to imagine situations they have never experienced.

In a paper presented at the meeting of the Association for Supervision and Curriculum Development, Dewey (2003) documents the changes in behaviour of teachers because of the use of video in teaching and learning. Educators perceived their role in a different way. For example, before using the video the educators' belief was that they model the best teaching and learning in classroom. They believed learners feel that they are knowledgeable about the topic and that they care for them and want them to be successful. With the use of video educators changed and indicated that they are no longer afraid to tell their learners that they do not have answers because learners have to know how to go about finding their own answers. Their focus shifted to the learners instead of the issue of their own competence. They now let learners construct their own understanding. At first educators were more

worried about classroom management and the environment than learners' needs and questions. After integrating video in teaching and learning for a month, they realised that learners better understood when they constructed ideas, and had opportunity to explain and to discuss in groups after viewing a segment of a topic.

Kellogg and Kersaint (2004) write that prior to using videos educators agreed that they faced a higher level of resistance regarding the use of reform methods. Educators often assert that many of the discovery approaches used would be difficult for learners, particularly when they themselves found the relevant mathematics challenging. This often meant that they rejected the possibility of using such approaches. However, after viewing the videos of students doing mathematics, talking mathematically, and presenting their findings, educators were better able to understand alternative approaches and considered their use.

Educators have a common view that video in teaching and learning provides learners to work independently and promote collaboration between students as they work on problems beyond the normal curriculum;

### **2.7.2 Learners' Perceptions**

Felder (2003) found that more than eighty students in a total of one hundred felt that the use of video brought mathematics to life. Imaginative computer animation, live action, music, special effects and a sense of humour make it possible to both absorb the given information and give valuable evidence in supporting their responses. It has been found to appreciably enhance students' results and experience by providing a more student-centred learning environment. Computer animation makes it possible for video to present live action and music. Learners believe that video initiate discussions in class, stimulate further research, and offers entertaining and informative insight into current research. Learners have realized that through the use of video, the learning of mathematics become exciting and intellectually rewarding. It encourages interaction between educators and colleagues. The learners said that the video sessions were more interesting than normal learning sessions. They brought variety to mathematics teaching and a chance to communicate with others by giving presentations. The video sessions also enabled them to discuss problems in mathematics.

## **2.8 Challenges Faced by Educators in Using Educational Video**

Though video seems to be a solution as far as teaching and learning of mathematics is concerned, educators and learners do face some challenges (Ellington, Percival & Race 1993). Some mathematics educators are still resistant to change. They are used to delivering their lecture “the good old way”, using blackboard and chalk. To them it is difficult to change because this is what they have been doing for years. Even after some training, they are still tempted to use the teacher-centred method.

Educators are also faced with the challenge of changing and giving up their role as the sole authority in the mathematics classroom. Now, their role is to help students build mathematics knowledge through the use of problem solving, to orchestrate classroom discourse in ways that facilitate students' learning. They are expected to use various tools like EV to enhance the teaching and learning of mathematics. They are encouraged to teach mathematics in ways that many of them have not experienced firsthand. In practice this often means that they have to imagine a kind of classroom which they may have never witnessed for themselves, and as a consequence they revert to the traditional way of teaching. To the educators, transformation seems not to be an easy task (Sfard & McClain 2002). Educators in South Africa are not an exception. They too are likely to cling to the traditional way of approaching education, but it is very necessary that they should change and use technology in their classroom and observe the results, such as we have noted thus far.

Cohen (1990) notes that educators still have to acquire skills both in selecting videos appropriately for the facilitation of the learning context so that the technology is curriculum embedded, and in creating achievable goals for learners' education.

Insufficient funding for technology-enhanced mathematics instruction is a problem touches every level of education, hampering the provision not just of technological infrastructure and tools, but also of adequate support staff and professional development opportunities.

## **2.9 The Barriers to Teaching and Learning Using Educational Video**

The principal barrier to this method is apprehension of the unknown. Educators and learners both worry about coping with video technology and initially felt self-

conscious about performing communicatively on air in front of their peers and people that they do not know, and this impacted on learners' learning interest. Learners, too, are uncomfortable at being watched by other people that they don't know.

Financial support is the other chief barrier: some learning institutions find it very difficult to integrate video in their teaching and learning of mathematics due to the costs. This brings constant worry that schools might at anytime raise their fees for video use to commercial rates, which could not be afforded.

Haddad and Jurich (2001) note that a further use for videos is to analyse teaching styles and idiosyncrasies, which can assist educational systems to change their approaches. The authors make the point that learning is a component of the educational process that cannot be attained without good teaching yet, even in developed countries, educators in general, and good educators in particular, are in short supply, with or without technological equipment,.

## **2.10 The Enablers**

To solve challenges met by schools in using EV in teaching, the Ministry of Education has to extend its budget to meet the requirement of schools, provide more equipment and provide the smooth running of technology usage in teaching and learning .

Schools should provide quality technological equipment and Internet training for members of the staff to enable them to access videos on-line. Furthermore educators must have access to professional development programs to enable them to master skills for the use of technology in the classrooms, so that learners benefit from skilled facilitation in their learning.

## **2.11 Conclusion**

Although there is convincing evidence that educational video can enable learners to improve their learning of mathematics and their test scores, literature indicates that there are still problems which are experienced in many classrooms. Educators are still inclined to resort to teacher-centred methods of teaching mathematics, with learners

still being expected to recite multiplication tables by heart. Most educators still think they are the only ones who have the knowledge and that they should be the only ones talking and asking questions in class. But there has to be a shift instead to learner-centred methods where the learners control, or are involved in, their own learning. As pointed out by Isman and Aytakin (2002), educators' methods that include the use of video and audio reach more learners and provide more opportunities for development in the learning process.

Literature has also indicated the specific potential of EV as a tool in teaching and learning of mathematics. It has shown its importance in mathematics instructions in that it caters for different learning styles, becomes a source of motivation in mathematics classrooms, and helps in the presentation of abstract concepts. The literature has also indicated the perceptions of both educators and learners on the use of EV, as well as challenges encountered by educators in teaching using EV.

The focus of the present case study is on the utilization, perceptions and challenges mathematics educators experience in using EV in teaching and learning, and this chapter gave an overview of what other scholars articulate about the contribution of educational video in teaching and learning. In the next chapter the focus will be on the elaboration of the theoretical framework of this case study.

## **CHAPTER THREE: Theoretical framework**

### **3.1 Introduction**

In the previous chapter the focus was on the ideas from different researchers on the use of video in teaching and learning mathematics. This chapter focuses on the theoretical framework determining the set of independent categories which underpin the present study. Theories and models used in this study are discussed in detail in this chapter.

### **3.2 Research design**

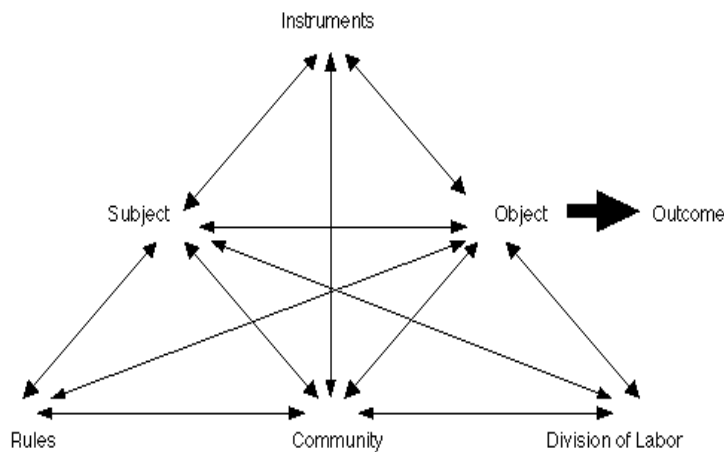
This research is informed by the constructivist ontology which assumes that for the learning to take place effectively, learners should be led to construct knowledge, be involved and achieve meaningful learning, and that this should be motivated by engaging them in the learning activities that will enable them find solutions to the challenges they encounter in the learning process. Engaging learners means that all the learning activities involve active cognitive processes such as creating, problem solving, reasoning, decision making and evaluation. Kearsley (1999) asserts that the use of technology in teaching and learning facilitates engagement in ways which are difficult to achieve otherwise. In order for the researcher to explore the use of video in teaching and learning of mathematics, two theories, engagement theory and activity theory, will be used to complement each other, and their principles, taken in conjunction, will help the researcher to collect data that will answer all the key questions of this study.

The basic idea underlying engagement theory is that students must be meaningfully engaged in learning activities through interaction with others and meaningful tasks. In this respect, technology use in teaching and learning facilitates engagement and constitutes a conceptual framework for (technology-based) learning and teaching. Engagement theory emphasizes collaboration among peers and a community of learners, with its main focus being on experiential and self-directed learning. The researcher also intended to understand the type of activities given to learners to

evaluate their assimilation of mathematics concepts, and this is the reason why activity theory is incorporated to complement engagement theory. Concepts from both theories, which will be used in the study in data collection and analysis, are elaborated towards the end of this chapter.

Activity theory embraces the idea that the human mind is the product of the interaction with people and artefacts in the context of everyday activity. Kaptelinin and Nardi (2006) see the incorporation of technology as an instance where activity theory offers a basis for understanding people’s relationship with learning. Their argument goes further and indicates that learning depends on prior existence of more complex cognitive structures. These more complex cognitive structures, however, are situated in the culture, not in the child. The child acquires them through interaction with adults who help the child do things that she/he could not do alone.

Vygotsky (1978) defines activity theory approach as a way to explore how the participating educators use tools, artefacts and resources to develop their practices and how, in a dynamic way, cultural tools contribute to shaping and transforming the pedagogies and teaching identities of educators (Karpov & Haywood 1998).



**Figure 2: Activity theory**  
(adapted from Kaptelinin, 1996)

Activity theory postulates that when individuals engage and interact with their environment, one consequence is the productions of tools. These can be both physical tools – such as notebooks, text books, hardware – and cognitive tools – such as mathematical concepts, software language and notational systems. Physical tools

shape what people can and cannot do; cognitive tools on the other hand enable (and can also constrain) activity. Activity theory believes that the human mind is the result of interaction with the world. It emerges and develops in order to make interaction more successful. The evolutionary origin of the mind is organic, and the interaction between human being and culture world is understood in terms of culture and society. (Kuutti, 1996). The concepts of activity theory are employed to help the researcher explore the change in learners' behaviour due to interaction with other learners through the use of video in learning.

The most fundamental principle of activity theory is that of the unity of consciousness and activity. "Consciousness" in this expression means the human mind as a whole, and "activity" means human interaction with the objective reality. It is in this context that activity theory, as illustrated in Figure 2, provides a language and framework for describing development. It is useful, furthermore, for expressing key features of the learning experiences, and for considering ways in which practice in subject areas was changing and reflected in teaching approaches. These experiences encourage consideration of the way that activity theory, together with engagement theory, might be useful in enriching our view of the utilization of educational video in the classroom.

**Table 2: Concepts of Activity theory in teaching and learning**

<b>Activity theory concepts</b>	<b>Technology role in teaching and learning</b>
Encourages collaboration	To cater for collaboration, technology (such as video) promotes multi-agency activity that enables learners to collaborate with other learners around the globe,
Varied virtual and physical contexts	The use of technological devices (such as video) enables learners to experience sharing of ideas with other students and be involved in practical work where they are engaged in their learning and able to construct their own knowledge.
Encourages hierarchical activities in learning	Technology promotes an expanded set of activities, beyond the classroom. Learners are involved in projects where they experience what it is like to be in the field of their future Profession.
Human experience in general (physically and emotionally).	Internal activities cannot be understood if they are analyzed separately from external activities. Change of behaviour of a learner reflects her understanding of the subject.

Table 2 is a researcher's model showing contribution of activity theory in teaching and learning with technology.

Activity theory encourages interaction among learners in the classroom and around the globe; technological can promote this by allowing learners to access discussions which involve learners from around the world through video-conferencing and online videos. Activity theory puts an emphasis on variety in virtual and physical contexts of learning; technology can provide these contexts to learners. Activity theory encourages hierarchical activities in learning; technology promotes the expansion of activities such as creating, describing, and analysing.

Externalization transforms internal activities into external ones and is often necessary when an internalized action needs to be "repaired" or scaled. It is also important when collaboration between several people requires their activities to be performed externally in order to be coordinated, analyzed and understood. Then from the two theories, engagement and activity, we can come out with the new theory that will be used to analyze and interpret data from this study

### **3.3 Concepts of the New Model Used in the Study**

#### **3.3.1 "Collaborate and relate"**

Engagement theory promotes human interaction in the context of group activities where learners collaborate with other learners, and of in-class exercises involving pairs of learners. This principle puts emphasis on team efforts that involve communication, planning, management and social skills. Learners are encouraged to clarify and verbalise their problems and facilitate solutions. According to Kearsley (1997), collaboration increases motivation in learners in that the learning situation is open for the contribution from colleagues. In other words, the problem is not particularly for an individual member, but for the whole group. Relating to these puts an emphasis on team work. The researcher therefore expects to explore the collaboration principle in learning of mathematics in the research situation.

#### **3.3.2 Projects-based learning and creating**

Conducting and defining their own projects is much more interesting to learners because they get to define the nature of their own projects; solving problems designed in the course of their own work makes learning a creative and purposeful activity. This gives them a sense of control over their own learning which is absent in traditional classroom instruction. The choice of the project involves a problem situated in the "real-world". Project orientation is the essence of problem-based learning approaches which are often used in professional education (Brophy. 2004). 'Create' emphasizes creativity and purpose, students have to define (or at least identify in terms of a problem domain) and execute a project in context (Kearsley, 1997). Learners' involvement in projects helps to train them for the future professions.

### **3.3.3 Authentic context learning with skills donation**

Engagement theory puts the stress on providing an authentic (meaningful) setting for learning. This component observes the value of making a useful contribution while learning. Ideally, each project has an outside "customer" that the project is being conducted for. The customer could be a campus group, community organization, school, church, library, museum, government agency, local business, or needy individual depending on the type of the project. In many cases, the projects can be work or career-related. This means an activity that fits into a team's occupational or career interests. The authentic learning context of the project increases students' motivation and satisfaction. This principle is consistent with the emphasis on school-to-work programs in many school systems and colleges, while the "service" donated stresses the usefulness of the outcome. While working on projects, learners interact with real-world customers and solve real-world problems. The advantage of this, according to Brophy (2004), is that learners gain an experience of interacting with an outside community that they are unfamiliar with, thus acquiring an important skill while still at school

### **3.3.4 Tools and artefacts**

These are all tools and instruments used in teaching and learning mathematics: samples, plans and ICT application devices. There are two types of tools: physical (notebooks, text books, hardware, etc.) and cognitive (concepts, software [including video], language, notational systems). Instruments include internal or external mediating artefacts which help to achieve the outcomes of the activity.

### **3.3.5 Rules**

Rules are practices that govern the process, such as collaboration with other groups of learners, that is being achieved through the use of tools. They are explicit and implicit norms – conventions and social relations within a school community – and are there to regulate actions and interactions within the activity system (Engestrom, 1987).

### **3.3.6 Community**

The community is comprised of one or more people who share the objective with the subject, like different people that learners connect with in their learning, for example

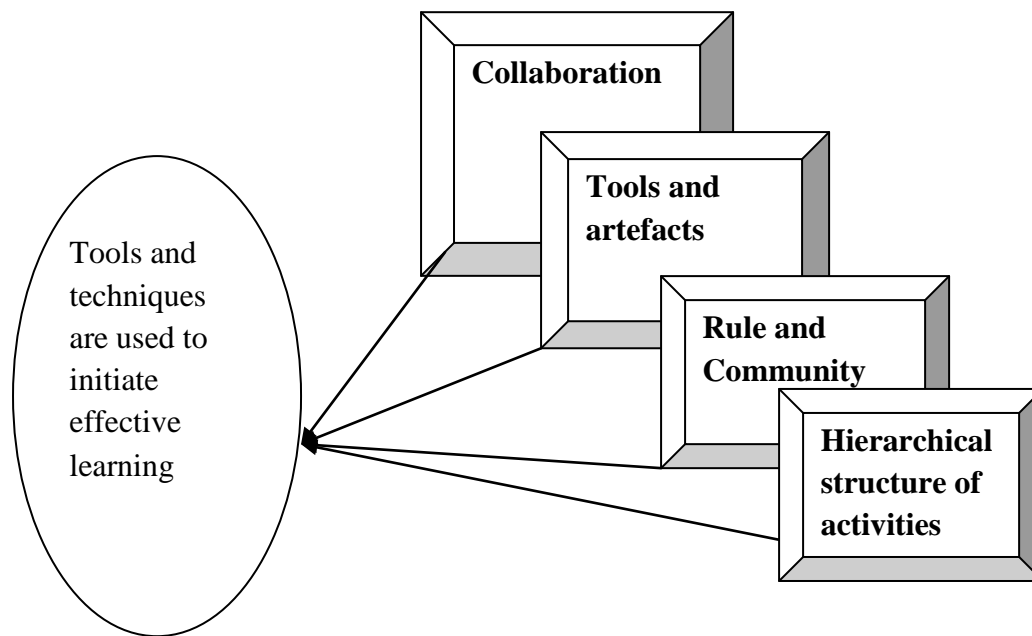
learning groups, school systems, professionals, community and society (Kaptelinin 1996).

### **3.3.7 Hierarchical structure of activity**

The hierarchy has three levels: activity, action and operation. Activities can be broken down into goal-directed actions that have to be undertaken in order to satisfy the object. Actions are conscious and implemented through automatic operations. Activity theory maintains that the elements of activity are not fixed, but can change dynamically as conditions change. Activities are not isolated units, but nodes in crossing hierarchies and networks which are influenced by other activities (Engestrom, 1987). Learners are to be given activities which are related to their experience to allow them to relate them with the already acquired knowledge before they are exposed to the more challenging activities.

### **3.4 A new theory model**

The reason for using these two theories (engagement and activity) is that they complement each other to enable the researcher to collect data that will answer the critical questions of this study. The following serves as emerging model which represents the principles of engagement and activity theories and was used to analyze and interpret data in this study.



**Figure 3: A researcher’s model showing the principles of the two theories combined as a new theory.**

Kearsley (1997) emphasises that collaboration is crucial for effective learning at all ages, and that video has the potential to enhance collaboration in teaching and learning where learners are involved in sharing of ideas with others as they work on a research project as a team.

Collaboration is also enhanced through authentic learning where learners donate their skills as a symbol of meaningful learning to people outside the school environments, such as to church or community organizations, or needy people. According to Kearsley (1997), learners should collaborate with other learners in order for them to effectively construct knowledge. Learning does not take place outside discussion and engagement. Hiebert and Wearne (1993) postulate that involvement and engagement of learners in learning enables high acquisition of skills.

The learners’ community, furthermore, contributes to the learning of the individual learner. What learners are experiencing from the environment in which they live determines the kind of knowledge acquired by the same learners in return. The role of the community is to support the learner’s needs.

The activities given to the learners to engage them in learning help to enhance group and peer learning. The techniques used in enhancing collaboration in the classrooms

have shown good results in the learning process, especially at the two selected schools. Kearsley (1997) states that EV has increased motivation in learners in that the learning situation is open for the contribution from colleagues, where the problem of finding the answer is a group task rather than an individual one.

### **3.5 Conclusion**

The principles of the new theory of the study will be used as themes in the discussion of data in chapter five of this current study. In the next chapter the researcher addresses the methodology of the study, reasons for methodological choices, and how it helped in the gathering of data.

## **CHAPTER FOUR: Methodology**

### **4.1 Introduction**

In this chapter there will be an examination of the phenomenological approach used in this study to clarify its central questions about the way people understand, interpret and use video in their daily teaching and learning of mathematics. This approach enabled the researcher to explore and understand both educators and learners' perceptions and challenges encountered in the use of educational video (EV) in the mathematics classroom.

### **4.2 Research Design**

Goddard and Melville (2000) define research as a process of gathering information which answers unanswered questions or creating that which does not currently exist. This is a process of expanding the boundaries of our ignorance as people to study the unknown and, as a result, find new areas of ignorance and discover useful information. This study aims at understanding how educators utilize EV in their mathematics classroom, as well as how they cope with challenges they meet in its use.

Qualitative approaches using interviews, classroom observations and document analysis have been shown to provide understandings that this study aims to achieve. Such understanding is about the use of educational video in facilitating mathematics instruction. Rather than seeking to arrive at generalizations, the study is concerned with deep description and the obtaining of first-hand data from the selected population. This was done in order to understand issues involved in the classroom which will otherwise be difficult to be understood if participants did not share their experiences (D'Onofrio, 2003). The researcher conducted a qualitative study to explore educators' and learners' experiences in using educational video in their teaching and learning of mathematics.

Henning (2004) argues that the best way to understand a phenomenon is to view it in its context, saying that qualitative researchers posit that there are multiple realities

constructed by human beings who experience a phenomenon of interest. In this case study, the reality about the use of EV in the classroom to facilitate teaching and learning is explored.

### **4.3 Interpretive Paradigm**

The researcher was guided by the interpretive paradigm in investigating how educators and learners perceive the use of EV (see Appendices A and B) and in observing how both educators and learners use and engage with EV to facilitate and access knowledge during learning (see Appendix C). The nature of the questions guiding this study – the “how” and “what” questions – calls for thick (rich) description, which means that the research question, too, makes an interpretive paradigm the most suitable paradigm for this study (Guba & Lincoln, 1994).

The ontology assumes that reality as we know it is constructed inter-subjectively through the meanings and understandings developed socially and experientially. Epistemology assumes that we cannot separate ourselves from what we know. Miles and Huberman (1984) argue that the interpretivists are not detached from their object of study. Instead, they have their own understanding, their own convictions and conceptual orientations. They are undeniably affected by what they hear and observe in the field; in other words the researcher and the participants of an investigation are linked such that who they are and how they understand the world is a central part of how they understand themselves, others, and the world. According to Berger and Luckmann (1967), the interpretive paradigm posits that the researcher's values are inherent in all the phases of the research process, and that the truth about the problem is negotiated through dialogue. Such dialogue is critical and needs to be fostered between researchers and respondents (Walford, 2001). It is through this dialectical process that a more informed and sophisticated understanding of the social world can be created.

The reason for choosing the interpretive paradigm is that it offered this study a better paradigm within which to operate: one where the ontology posits that there are diverse and multiple truths. The world in which the exploration takes place is a largely unknown entity in which people must keep their options open and not restrict themselves in advance by limiting their exposure with rules and hypotheses. Instead,

they should let people share their experiences to help us understand the phenomenon better. By so doing, we will open the ways that are the best to discover, not just a few isolated facts, but also some deep-lying secrets of nature (Patton, 1990)

The interpretive paradigm is found appropriate for the study because it enabled the researcher to explore how the integration of video in teaching and learning improves motivation and gives better performance in learning mathematics.

#### **4.4 Qualitative Approach to Research**

Qualitative researchers aim to gather an in-depth understanding of behaviour and the reason that govern human behaviour, and this is why qualitative research concerns itself with the reasons behind various aspects of . It is often used to gain insights into people's attitudes, behaviours, concerns, motivations, aspirations, culture or lifestyles. The sample size is small and does not represent the whole population; hence findings cannot be generalized (Cohen, Manion and Morrison, 2000). Qualitative research, furthermore, is about exploring issues, understanding phenomena, and answering questions.

In qualitative research, the data analysis process begins during data collection as the data already gathered are analysed and shape the ongoing data collection (Henning 2004). This study used preconceived themes; the emerging categories were added as they became apparent. The following steps were followed during the analysis process: data reduction, data display and drawing conclusions.

#### **4.5 Case Study Methodology**

The history of case study goes back to Europe and France in the 1920s. It was mostly used by reporters who were interested in reporting issues of poverty, unemployment and other conditions deriving from immigration. Case studies are employed in qualitative research, and each selected case is studied in depth.

Yin (1994) and Zonabend (1992) write that case studies are records of innovative or good practice. They record specific problems or issues experienced by a person or a group and the actions taken to overcome the problems. Their purpose is to promote

these actions to other people. They are often used where there have been limited solutions found to a particular problem. Case studies generally report factual information as well as opinions (good and bad). This is the reason case study was found suitable as part of the methodology of this particular study because it enabled the researcher to find the in-depth data in order to explore the ways in which educators and learners experience the use of video in education.

Case study furthermore, enabled the researcher to record the experiences of educators and learners of the selected schools on the use of video in mathematics teaching and learning. Yin (1994) and Zonabend (1992) say that case study is an ideal methodology when a holistic, in-depth investigation is needed which incorporates the views of the "actors" in the case, while Gray (2004) points out how the focused nature of case studies makes them suitable for exploring performance, extending experience and increasing confidence about a subject. This case study was employed as a methodology to enable the researcher to find in-depth data on the case under investigation. It addressed these key research questions.

- How do educators and learners currently utilize EV in teaching and learning mathematics?
- What are the perceptions of educators on the use of EV in teaching and learning of mathematics?
- What challenges are faced by educators in using Educational Video in mathematics education?

#### **4.6 Research setting**

The real names of schools were not used at any point of data collection, or in the written case report. Instead, for the schools, educators, learners, other persons and names of places, pseudonyms were used. The fictitious names used for the two selected schools in this study are Makintane and Sekameng High Schools.

The schools which were selected to participate in the study differ in many aspects. In Makintane High School there are over one thousand learners, while at Sekameng High School the number of learners is five hundred. Learners who come to Makintane High School is a boarding school where learners come both from

neighbouring townships and from much further afield. It is well-resourced, with a reputation of being one of the best black schools. The principal was a middle-aged man who seemed to be excessively busy.

Sekameng High School has a lady as its principal, who was at pains to allocate time for local responsibilities such as guiding the staff and learners and providing for their different needs which fall within the ambit of a principal's duties. She was never too busy to give help when required to do so and was always available whenever the researcher needed her.

Learners in grade ten were between fourteen and sixteen years of age. In both schools classes have been divided into smaller divisions.

#### **4.7 Sampling**

A sample is a subject chosen from a population for investigation. There are different types of sampling. Although purposive sampling is one technique often employed in qualitative investigation, the researcher included random sampling as well. The intention was to explore and understand ways in which educators and learners from South Africa use video integration to facilitate the learning of mathematics.

##### **4.7.1 Purposive Sampling**

As Patton (1990) describes it, in purposive sampling subjects are selected because of some characteristics. Purposive sampling was employed in this study to enable the researcher to collect data from the knowledgeable group on the subject investigated, and this was used in the selection of the schools. The researcher intended to collect data from schools that use EV in their teaching and learning of mathematics. The schools selected in the sample have both used EV in teaching and learning for at least a year. The researcher is aware that the sample selected this way may not represent the total population of all the schools using EV in teaching and learning in South Africa. As a result, the findings of the study would not be generalized, but can be transferred and be used in contexts similar to the one used for this study (Henning 2004).

#### **4.7.2 Systematic Random Sampling**

In random sampling, each item in a population has an equal chance of enclosure in the sample. The number of learners in grade ten was too large for all to participate in the study and random sampling was used to select learners; this was accomplished by first numbering the individuals in the population. In one of the schools the focus was on a class of eighty-five grade ten learners while in the other school there were fifty learners in the class. The first participant was randomly chosen by putting all the names in a container and asked a student to choose the number (with a name on) which serves as a starting number. From there every seventh name was selected until the desired number of subjects was obtained, selected from both girls and boys. Selected learners were given informed consent forms to give to the parents to permit their children to participate in the study (See Appendix E). Those that were allowed by their parents to participate were interviewed. Two grade ten mathematics educators from each school participated in the study. They were also asked to sign the informed consent. The grade ten learners were observed from the two schools and the observation process was performed based on the observation schedule designed by the researcher (See Appendix C).

#### **4.8 Participants' Profile**

Participants of this study fall into two groups: the grade ten mathematics educators from the two schools, and the learners.

##### **4.8.1 Educators**

Four of the participants were mathematics educators in grade ten. The two educators from the first school (Makintane High school) are males. The first one, referred to as John in this study, is in his late forties. He is the head of the mathematics department, and has been working at the school for longer than many of the other teachers in the school. He is a qualified mathematics educator with fifteen years of teaching experience.

John has never been in a situation of collaborating with students other than those in his own class. The resources they had used when he himself had been a learner at school were confined to the textbooks, which were few and had to be shared with

other students. Their reference and knowledge relied solely on the prescribed books for their grades.

Though John has never undergone any training on the use of technology in his training college, he has been to training workshops on using technology in teaching and has used video in teaching in both GET and FET (grade 7 to 9, and grades 10 and 12).

The second participant, Mathew, is in his late twenties. He is currently pursuing his degree in which some modules include educational technology. He enjoys teaching using technology, which is shown in the way he uses video in presentation of his lessons. He is a trained educator with five years experience. He will be completing his degree in the next couple of months.

The educator participants from the second school were Anne and Mark. Mark is in his early thirties. He has attended a workshop on the use of technology in the classroom. This has never been an easy task for him although he is a qualified educator and he has taught mathematics for a year. Anne is a technology teacher in the school. She is currently enrolled with the University of KwaZulu-Natal doing her Masters in Educational Technology. She is competent in her mathematics classroom.

#### **4.8.2 Students**

##### *Makintane High School*

Learners from this school are between the ages of fifteen and eighteen. They have experienced learning mathematics using educational video for not more than a year. The majority of the learners had video players at home and they are familiar with gathering information from the videos and from the internet, even though such information was not for learning.

Using video for learning mathematics did not seem to be too problematic for these learners. They could link the experience that they had with the use of video at home with the use of EV in learning mathematics.

### *Sekameng High School*

The school is situated in a semi-urban area. Learners from this school are aged between fifteen and nineteen. They were two girls and three boys from the places around the school. They had videos at home where they used to watch different movies for entertainment. They have used video in learning for a year and could successfully use the given video materials.

#### **4.9 Methods of collecting data**

Henning (2004) argues that in the interpretive paradigm knowledge is constructed not only by observable phenomena but also by descriptions of people's intentions, values, and reasons, meaning making and self-understanding. In this context, interviews, observations and document analysis were used to find how educators and learners understood, perceived and used EV to improve learner's performance. Berger and Luckmann (1967) comment that interpretive approaches rely heavily on naturalistic methods such as interviews, observation and the analysis of existing texts, which, according to Berger and Luckmann (1967), ensure an adequate dialogue between the researchers and those with whom they interact in order to collaboratively construct a meaningful reality. Generally, meanings are emergent from the research process. Typically, qualitative methods are used.

##### **4.9.1 Semi-structured Interviews**

Interviews are two-person conversations initiated by the interviewer for a specific purpose of obtaining research-relevant information (Henning, 2004). They are very personalized and allow opportunities for the participants to respond freely and reveal their attitudes and feelings. The researcher observed that interviews are not easy and when educators were answering questions, some would respond to questions not asked. The researcher had to wait for the educator to finish and repeat the question. This consumed a lot of time.

The interview was chosen as the primary instrument to gather data, and was used to collect the in-depth data on the use of video in teaching and learning of mathematics. This method helped the researcher to establish a relationship with participants and as a result they opened up and were ready to share their experiences. This atmosphere

helped the researcher to probe participants to clarify and elaborate more on the issues of concern. On the other hand, it helped to clarify questions which seem to be ambiguous or which can be interpreted differently by participants.

This also provided validity in that in the process of conversation: participants were able to confirm their discussions.

The researcher used semi-structured interviews. This method was beneficial in this study because the researcher came into the session with the schedule, which was easy to consult as the interview session proceeded. The interview technique helped the researcher to observe and record non-verbal behaviour. It also allowed impressions of respondent's gestures and tone of voice which gave additional evidence of their responses and confirmed what was heard by the researcher. The data collected through interviews was recorded and was transcribed and arranged into categories to ease the analysis of the data which was to follow. After each interview session the participant would be given an opportunity to check if the recorded data reflected what he/she said. Mistakes were able to be rectified on the spot. This was done with one school while in the other school, due to the time factor, the conclusion was read to the participants to confirm the correctness.

#### **4.9.2 Disadvantages of Interview Method**

Patton (1990) states that interview method generate large amounts of data that may be converted to text in a very short interview. When transcribed, however, it covers many pages of text and this can easily be overwhelming for the researcher. It is expensive and difficult to analyze the data because the researcher will not necessarily know or be able to decide what is and is not relevant. This limitation of the interview method was solved by adoption of the first step in data analysis suggested by Miles and Huberman (1984), namely data reduction, which refers to the process of selecting, focusing, simplifying, abstracting and transforming the data that are written on the field notes and transcribed from recorded interview. Miles and Huberman (1984) argue that it is in this stage where a researcher makes decisions as to which data chunks to code and which to pull out; this enables categorizing and producing themes

Henning (2004) writes that during the interview process, participants may give false information due to feelings of embarrassment, inadequacy, lack of knowledge on the topic, nervousness, memory loss or confusion. This is what the researcher experienced while interviewing educators: some were ashamed to admit that because of the challenges they encountered in using video in teaching, they opted to revert to the traditional way of teaching mathematics, and this did not help the learners to improve their assimilation of mathematics. Through further questioning it was discovered that some of educators were reluctant to change from the traditional way of teaching where learners had no exposure to any materials beyond what they encountered in the classroom.

#### **4.9.3 Interviewing Educators**

On a number of occasions the educators were not available for interviews. In some cases they were committed to other duties and in other cases there was a lack of interest or the fear of judgment from the researcher. These problems were solved by reading together the informed letter, which states clearly that the focus of the study is on how video is used and to understand how it can enhance learners' performance in mathematics learning. The researcher would go back to the concerned persons to arrange a new appointment and this delayed the process. Another factor was the workshops that the educators attended which interfered with the researcher's schedule.

#### **4.9.4 Interviewing Learners**

In both schools the timetable was not consistent. As a result, appointments had to be changed time and again. The semi-structured interviews for the learners were conducted with a total ten learners from two schools, five from each school, including both boys and girls.

#### **4.9.5 Observation**

The researcher used the observation schedule to observe the teaching in the classroom. This method was found appropriate for this study because the performance of both teachers and learners were observed and experienced. The researcher observed educators as they go about their activities in real-life settings. An observation contributed in that it allowed the researcher to observe behaviour in the

setting in which it normally occurs. The data from observation were used to validate the data from interviews and served as a means of triangulation (see later).

The data gathered through the use of observation is considered to be the reality because it covers events in real time, and is contextual. It was possible to record interactions that happened quickly, perhaps even outside of the conscious awareness of either educators or learners, whereas with other methods (such as questionnaires) it becomes difficult for the teacher to remember classroom events. Furthermore sometimes questions can mean different things to different teachers (Creswell, 1998).

#### **4.9.6 Limitations of Observation**

Guided by the observation schedule the researcher could select points that she considered important. The presence of the observer might cause change and learners may behave differently as well as the educator, and this can affect the findings. Again, observation can be biased because of the particular interest of the individual researcher. To minimize this weakness the researcher first visited the class and spent the day with them while the observation was done on the next day; this was done to familiarise both learners and educators with the researcher.

#### **4.9.9 Document Analysis**

Documents are stable sources of data gathering since they do not change. Once they are written, they are there to be used and can be reviewed repeatedly. They contain precise details of names and events in broad coverage. Some documents are written prior to the case study and are thought to be free from author's bias as far as the matter under investigations is concerned.

The documents that were reviewed by the researcher included:

- (1) Records of previous years' test results of grade ten students in Mathematics.
- (2) Timetables, from which the researcher was able to find out the time allocated per week for Mathematics.
- (3) The budget for technology devices. The interest here was to find out if the schools have an intention of buying technological equipment.

(4) The technology plan for the school. This would go hand in hand with the budget. but the aim was to see whether the schools have a plan for integrating more technology devices in future.

(5) The Mathematics syllabus. This was reviewed to observe what official expectations there were in regard to teaching approaches, and whether there are suggestions on the use of technology in teaching.

All of this documentation (especially the technology plan and the budget) has a direct bearing on the data given by educators and learners from that particular school, influencing the way educators of the same school utilize technology devices, and also reflecting the determination of both educators and learners in the involvement with technology in the classroom.

In the first school (Makintane High School) the records were not kept well, and could not reflect results from three years back, while in the second school (Sekameng High School) the records were well kept.

#### **4.9.10 Disadvantages of Document Analysis**

Documents may be insufficiently up to date to be useful evidence of what is currently going on in the institution, although they may provide a longer-term perspective of events and settings. The records of the performance of learners were valuable for they could validate data from both interviews and observations.

When there is easy access all the time to this kind of documentation there is often a lack of confidentiality in the organization. Documents are biased for they report only issues that interest the reporter; those that are not interesting are left out, even if they are of value to other people. The researcher reduced this by analyzing both test scores and marked scripts of the learners to see if they reflected the same picture of the gained scores in the last two tests written by grade ten students, even though learners' scripts were not well kept, and some were missing. Only the available ones were used.

#### **4.10 Triangulation**

The use of a variety of methods of collecting data, known as triangulation, is a technique in the social sciences to attempt to map out or explain more fully the richness and complexity of human behaviour by studying it from more than one standpoint.

Triangulation is the use of a combination of research methods in collecting data in a study. Case studies are said to be much more convincing and accurate if they are based on several different sources of information (Yin, 1984). The researcher used a variety of methods of collecting data to enhance validity of the study. Both methodological and theoretical triangulation helped the researcher in that more than one theoretical schema was used to interpret the phenomena, and also what was not stated in the interview was found in the observation and would be substantiated in the document analysis. A multi-method approach to collecting data was used in this study to enhance the researcher's confidence that data collected are not artefacts of one specific method, following the recommendations of Cohen, Manion and Morrison (2007). Their argument is that the more the methods concur with one another, the greater the researcher's confidence.

Triangulation was used in two ways in the study: firstly to increase the reliability of the data and the process of gathering it; secondly to confirm the data gathered from other sources. The use of more than one method of collecting data helped to overcome what Cohen, Manion and Morrison (2000) call a problem of "method-boundness", which means that there is no self-sufficient method, and that it is better to use a variety of data sources rather than relying solely upon one avenue of data; in other words, methods complement each other in validating the gathered data.

#### **4.11 Trustworthiness**

Lankshear and Knobel (2004) recommend that the quality of the study in each paradigm be judged in accordance with its paradigm terminology. *Reliability*, *validity*, *generalization*, and *objectivity* are terms used by positivists to measure the rigour of their studies, while the set of terms used by interpretivists would be *trustworthiness*, *credibility*, *dependability*, *transferability*, *conformability* and

*crystallization*. The term *trustworthiness* was used to emphasize the importance of using the appropriate terminology for measuring the rigour of this current study, although the terms *validity* and *reliability* will still be used in the study for the sake of clarity and emphasis. Lankshear and Knobel (2004) write that trustworthiness is concerned with the believability of the study and the degree to which a reader has faith in the study's worth; in this sense trustworthiness depends on researchers clearly demonstrating that they have collected data that are sufficient for their research needs.

These related research issues required the study to consider whether it is investigating what it is supposed to be investigating and whether the measures used are consistent; so these questions of validity and reliability are of particular importance for the case method because of the reliance on data that is generated from either limited or particular samples or situations.

Yin (1994) writes that constructing validity has been found to be problematic in case studies; it has been difficult to define constructs being investigated since explanations of the case depend on the ability of the researcher to clarify it and also on his/her personal impressions when defining the concepts. This might have been the case with this particular investigation. The problem is minimized by the selection of appropriate theories to help to define concepts used in the case, and using multiple sources of evidence (with instruments such as the semi-structured interviews schedule and an observation checklist) to collect multiple data helped the researcher to define concepts. During the data collection process using the three diverse methods, the researcher established evidence by quoting real words from participants to validate collected data.

Validity and reliability in qualitative research are based on the trustworthiness and quality of the study, therefore validity and reliability are two factors which any qualitative researcher should consider when undertaking a study in order to persuade the audience that the research findings of an inquiry are worth paying attention to (Golafshani, 2003).

In this study the validity and reliability have been ensured by using triangulation (deployment of different methods of collecting data) in order to pick up the facts which might be left out by other methods. The researcher went back to the settings for confirmation of the results as the way of enhancing the validity of the study. Where

there was limited time, participants were given the interview transcripts to justify the information and then scripts were collected later.

#### **4.11.1 Some other strategies used in improving trustworthiness of the study**

##### *Prolonging the processes of data gathering on site*

Although it was time for semester tests, enough time was spent on both schools interviewing and observing both educators and learners. In the second semester the researcher went back to continue with data collection which was followed confirming the findings. This ensured the accuracy of the findings and provided the researcher with more concrete information which enabled her to formulate interpretations.

##### *Conducting member checks*

This is when data, analytic categories, interpretations and conclusions are tested with members of those groups from whom the data were originally obtained (Lincoln and Guba, 1985). For example, the researcher talked to the participants about the truth of what is collected and was open to corrections from the participants; they were given an opportunity to confirm the data collected by reading to them what is written at the end of the interview sessions. Lincoln and Guba (1985) single out this technique as the most crucial one for establishing credibility, although it is controversial. Morse (1994) and Sandelowski (1993) comprehensively reject the use of member checks for establishing the validity of qualitative research and state that in many instances member checking results in confusion rather than confirmation. Due more to the fact that participants may disagree with researchers' interactions than to the question of whose interpretation should stand, this is especially an issue in the case of interpretive perspective, where understanding is co-created and there is no objective truth or reality to which the results of a study can be compared. In this study, more useful information was obtained through the member-checking technique.

##### *Engaging in peer consultation/debriefing*

Prior to composing the final draft of the report, the participants were consulted in order to establish validity through pooled judgment where the researcher contacted the participants to find their opinion on the records of findings.

#### **4.12 Ethical Issues**

During data collection, care was taken to ensure that rights of participants were maintained. Permission was asked from the principals of the schools (the letter of permission is attached in the appendix). Participants were informed of the objective of the study and were assured of the confidentiality of the data given, as well as the anonymity of their participation. They were informed that their participation was voluntary and that they were free to withdraw at any stage of the study, and they were assured that their withdrawal would bring no harm to them.

Therefore, care was taken to ensure that the rights of participants were maintained. The permission was requested from the Faculty of Education of the University of KwaZulu-Natal (letter of permission is attached in the appendix D). The participants were given an informed consent form which, according to Cohen, Manion and Morrison (2000), is the procedure in which individuals choose whether to participate in the investigations or not. Henning (2004) recommends that the participants should be allowed to sign a consent form before they commit themselves to participate. This is done to confirm that they have understood what the study is all about and agree to participate. For ethical reasons the names given to both schools and participants are not the real ones.

#### **4.13 Proposed Analysis of the Data**

Data analysis consists of examining, categorizing, tabulating, or otherwise, recombining the evidence to address the initial propositions of a study (Yin, 1994). The analysis of a case study is one of the least-developed aspects of the case study methodology. The researcher needs to rely on experience and availability of the literature to present the evidence in various ways, using various interpretations.

The guided approach was used to analyze data using the concepts from both engagement theory and activity theory; this helped the researcher to work on the data gathered having a pre-prepared frame of analysis. The use of concepts adopted from the theory is a theoretical propositions technique as suggested by Gray (2004), who indicates that the role of theory in the study is to help the researcher to determine what is important to be investigated and to guide objective and questions of the study.

Therefore the theoretical models have been predicated to guide which position can be supported or rejected. The concepts of both theories (engagement and activity) were used to interpret and analyze the data in this study by formulating themes and suitable categories to enable the discussion of the data collected. Lankshear and Knobel (2004) argue that themes should be used to analyze multiple kinds of data. The data will be presented and illustrated graphically (using pie charts, graphs and bar graphs) in the next chapter.

#### **4.14 Pilot study**

A pilot study was undertaken to test the following:

- Ambiguities of the questions
- The time management and length of each interview session
- Grammatical errors.

The participants in the pilot study were Masters students at the University of KwaZulu-Natal (Edgewood Campus) specializing in Educational Technology, selected because they were educators in Technology in their respective schools; they qualified as an appropriate and knowledgeable population to consult. They are in the real situation of teaching mathematics in the classrooms using technology devices.

The semi-structured interview was administered to explore students' experiences as teachers of mathematics and students of educational technology. The validity of the pilot study mostly relied on the fact that the participants were experienced educators and users of technology in teaching, and were doing their module on how to use video in teaching and learning. The results of the pilot study were:

- The time management of the pilot was well balanced
- Interviews were conducted well
- Questions which were observed to be ambiguous were corrected
- There were no grammatical errors.

#### **4.15 Conclusion**

In this chapter, the researcher has elaborated on how the data was produced and has indicated that it was important to explore how educators and learners utilize educational video in the teaching of mathematics, as this would help to improve results in mathematics. This has been a problem in our country for decades and has been discovered to be gradually deteriorating (Lubisi & Cronje 2007). In the next chapter the focus will be on the reproduction and analyzing of data.

## **CHAPTER FIVE: Data analysis and interpretation**

### **5.1 Introduction**

In this chapter the intention is to analyze data, followed by its interpretation, which is done based on the researcher's understanding and participants' responses. The data were collected to explore the use of educational video (EV) to facilitate learning in mathematics learning area. The study is aimed at developing an understanding of the use of EV in classroom, perceptions and challenges encountered by educators in using EV. The key questions guiding this study are;

- How do educators and learners currently utilize EV in teaching and learning mathematics?
- What are the perceptions of educators on the use of EV in teaching and learning of mathematics?
- What challenges are faced by educators in using Educational Video in mathematics education?

This chapter presents a summary of data collected from educators, learners' interviews, and classroom observations, and from documents comprising tests records, timetables, syllabuses, Technology Plans and budgets. The data is presented in a simple way for the readers to observe and understand how educators and students of the two selected schools in KwaZulu-Natal Province utilize EV in teaching and learning in mathematics classrooms – their perceptions as well as their challenges.

### **5.2 Data Analysis**

#### **5.2.1 Qualitative Data**

Qualitative data is derived from the informants' experiences. The collected data has to be organised, and interpreted. It is used in the exploration of meanings of social phenomena as experienced by individuals themselves, in their natural context (Henning 2004).

Miles & Huberman (1984) suggest that analyzing qualitative data consists of three elements: Noticing, Collecting, and Thinking about interesting things. They outline three categories in data analysis:

*Data Reduction:* This refers to the process of selecting, focusing, simplifying, abstracting and transforming the data that are written on the field notes and transcribed from recorded interview. It is in this stage where a researcher makes decisions about which data chunks to code and which to pull out.

*Data Display:* This refers to organized, compressed assembly of information that permits conclusion drawing and action. It helps the researcher to understand what is happening and to do something either to analyze further or take action on the understanding.

*Drawing Conclusions and Verifying:* These two mentioned steps help in the making of conclusions which are based on the understanding obtained from the previous steps.

Both analysis and interpretation of this study is based on the guided approach, and the interpretation of the researcher influenced by the above mentioned steps performed in the analysis process of these data. The records of the truths about the practices and perceptions of educators and learners in the classroom might have influenced both by literature reviewed and the assumptions and beliefs of the researcher.

### **5.3. Presentation of Data**

Each question has its own intention, question and then responses.

#### **5.3.1 Interviews with educators**

*1. In what way does educational video (EV) help you to facilitate mathematics instruction?*

The intention in asking this question was to explore how educators in two selected Durban schools utilize EV in their classrooms. The responses answered Critical Question One (How do educators and learners currently utilize EV in teaching and learning mathematics?).

Responses:

John: *It saves time; it also captures learner's attention and demonstrates abstract concepts.*

Mathew: *It helps to motivate learner's attention; it also makes the work easier when teaching, especially with large number of students we have in our schools.*

Mark: *It is a show so learners view activities and this makes it easier for them to understand, it helps us with large class rolls we have. It also helps us to introduce abstract concepts.*

Anne: *Sometimes it is not easy to teach other concepts because they are difficult, but with video they become easier to teach, it helps me to teach those concepts and also saves time.*

The four educators gave the responses on ways in which EV helps in teaching mathematics. Two educators indicated that EV saves time, helps capture learners' attention, make things visible for learners. Two educators said that it makes work easier when teaching large classes, and helps to explain abstract concepts.

## ***2. What teaching techniques are introduced by integrating Educational Video in mathematics lessons?***

The intention of the researcher in asking the second question was to understand techniques and practices that were performed in the classroom both by educators and learners which promoted effective learning to occur. The responses answered Critical Question One (How do educators and learners currently utilize EV in teaching and learning mathematics?)

Responses:

John: *Learners are engaged in their learning and discussion. "After presentation learners are asked to form groups and write reports on the issue presented. Each group is asked to present its findings and other groups are given a chance to ask questions.*

Mathew: *It enables my students to work in groups, with their friends. They collaborate with other learners. If there are not enough materials, learners can watch*

*how it is being done on the video in class or at their own time. It brings variety of learning into the classroom and it also promotes discussion between learners and colleagues. Learners also become engaged in their learning.*

*Mark: EV promotes discussions in the class; it enables my students to work in groups.*

*Anne: Learners are now able to talk in the class, they are able to discuss with their colleagues. They are engaged and they discuss with each other. Learners are experiencing a new ways of learning from EV. It also helps where there are not enough materials in the classroom; learners can watch video presentations in the class or at home.*

Three educators stated that EV enables learners to engage in their learning, two said it enables collaboration, two indicated that EV brings variety of learning in the classroom while all four educators indicated that EV promote discussions between learners and other learners.

### ***3. How do you rate the impact of integration of educational video in teaching in terms of learners' performance?***

The reason for asking this question was to explore the development in learners' performance in mathematics subject which Lubisi and Cronje (2007) state is gradually deteriorating in South African schools. The study sought to understand how educational video impacts teaching and learning of mathematics in two selected schools in Durban. Responses answered Critical Question Two (What are the perceptions of educators on the use of EV in teaching and learning mathematics?).

Responses:

*John: The learning has improved, this is shown by the results of our learners in mathematics, and they have improved. We have few students who fail mathematics in our classes, this good performance is the result of integration of video.*

*Mathew: Performance in mathematics was low before the integration of video in teaching and learning, but now it has improved.*

*Mark: There isn't that much of improvement in the performance of learners, I would expect more than what I see now. I would expect learners to pass more because there*

*is that chance of experiencing different approaches used in solving mathematics problems from the video.*

*Anne: The integration of EV has helped our students to improve their performance. They are now able to solve problems even the challenging mathematics problems.*

Out of four educators, three indicated that integration of video in teaching and learning of mathematics improved, while one said there is little impact and that there isn't as much improvement of learner's performance in mathematics as was expected.

#### ***4. Why do you use EV as a teaching mediator in mathematics in Grade Ten?***

This question was asked to understand the perceptions of educators on the use of EV in education. The responses answered Critical Question Two (What are the perceptions of educators on the use of EV in teaching and learning of mathematics?)

Responses:

*John: EV helps learners to understand abstract concepts of mathematics. If material was there I would use it frequently but there are no materials for topics in Grade 10 so I don't use it that often.*

*Mathew: It promotes discussion in class I feel comfortable to use it. I use it at least four times a week. I enjoy facilitating my mathematics lessons through technological means to cater for individual differences, so I use it often. But there is a need to have enough materials; our problem is that there are no videos for all the lessons.*

*Mark: Video is a tool for learning that enables me to facilitated learning of mathematics. if the material was enough I would use every day because of its effectiveness in teaching, but there is no material so I don't use it regularly.*

*Anne: If the school does not have video material I used to borrow them from the University. So I use it often, I believe not less than three times a week because video benefits students in their different learning styles and ability e.g., those that have low learning capability and those with barriers like language, social skills, culture and learners with special educational needs.*

Two educators stated that integration of EV into their classrooms enabled them to be just facilitators in class while learners construct their own knowledge. One said EV

helps learners to understand abstract concepts. One indicated that EV promotes class discussion.

### ***5. What challenges do you encounter in integrating EV in the classroom?***

The reason for asking this question was to understand the different challenges educators and learners experience in the classroom in using EV. Responses answer Critical Question Three (What are the challenges faced by educators in using EV in mathematics instruction?)

Responses:

*John: The challenge that I usually meet is to make a good choice of material for each individual lesson which will help my learners to achieve the lessons' goals.*

*Mathew: There are not enough materials at the school. There are no funds to buy materials. Our school is poor. Sometimes learners don't reach lessons' outcomes because of lack of materials, so EV helps in those cases. But we also need to know which materials or cassettes are appropriate for a subject. We need training on this issue to enable us to choose the appropriate materials.*

*Mark: We need a refresher course on the use of video to achieve the objective of the lesson. The technical issues are still a problem sometimes the video gets stuck and we don't know what to do.*

*Anne: We need to access video conferencing like other schools in other countries but the problem we have is the infrastructure. Our school is in the rural area and there are no means, but we like to experience its use in teaching and learning. We also need to have new video materials. Our colleagues do not know how to operate these devices so they use to come to my class for a help and this delay my class work. I think staff empowerment on the use of technology including the use of EV in teaching is needed.*

Three educators indicated that they need skills to make an accurate choice of the appropriate video to use for a particular content, they don't have enough materials, and that video conferencing is not applicable in their context due to lack of training, and infrastructure. One said that they do not have skills to create achievable goals for teaching using EV, and that they lack funds too.

## ***6. Can you recommend the use of EV to other educators?***

The purpose of the question was to understand educator's perceptions on the use of EV in teaching and learning.

Responses:

*John: EV as a technological device that brings a lot of collaboration learning in the classroom, it is capable to introduce constructivist learning. I would be pleased to see it being used in every classroom.*

*Mark: It enables us to move away from teacher centred approach and encourage the introduction of learner centred approach. Learners are allowed to learn at their own pace. It enables learners to access materials outside the classroom; I encourage other educators to integrate it in their classroom.*

*Mathew: The integration of video in teaching and learning mathematics allow learners to work with other learners and educators from different countries are able to share their skills in teaching mathematics to their colleagues in other countries through EV. All educators should use video because it is a cheap technology which can be used as a starting point to more expensive technologies. Video enables learners to view the lecture as many times as needed by an individual learner. Video also enables learners to be engaged in their learning.*

*Anne: After presentation learners are asked to form groups and write a report on what they have understood. Each group is asked to present its findings and other learners asked questions. Every learner in South Africa should be given chance to experience its utilization.*

All the four educators said that they highly persuade other educators to integrate video in their classrooms because, it increases the level of motivation in learners and provide better understanding of concepts, educators from the first school (Makintane high school) indicated that since is one of technological devices it brings a lot of collaboration learning in the classroom, it is capable to introduce constructivist learning. It makes it possible to move away from teacher centred approach and encourage the introduction of learner centred approach. It allows learners' pace. It enables learners to access materials outside the classroom.

Two educators from the second school (Sekameng high school) show that integration of video in teaching and learning mathematics allow learners to work with other learners and educators from other countries in the world. They also indicated that other educators should use video because it is a cheap technology which can be used as a starting point to more expensive technologies. Educators emphasize the fact that video enables learners to view the lecture as many times as needed by an individual learner. According to the educators video also enables learners to be engaged in their learning. Through video learners can work with other learners from the class and copy some ideas of other learners around the globe through presentation of lessons, this has contributed in allowing learners access materials from other classrooms.

### 5.3.2 Interviews for learners

Learners' responses were used to validate the data collected from educators, with the philosophy that educators work together with learners in the classroom; they are both witnesses of the practices taking place in teaching and learning. Ten learners were interviewed; five from each school, the following are their responses.

Figure 4 below presents responses from learners: Four of them indicated that EV promotes sharing of ideas with other learners in the classroom and encourages concentration. One said it promotes independence in learning. Two indicated that it enables them to loan materials and watch at home. One said it helps teachers to teach effectively. One said it is a fresh way of learning. One indicates that they access materials from other countries.

How does EV help you to improve your assimilation of mathematics education

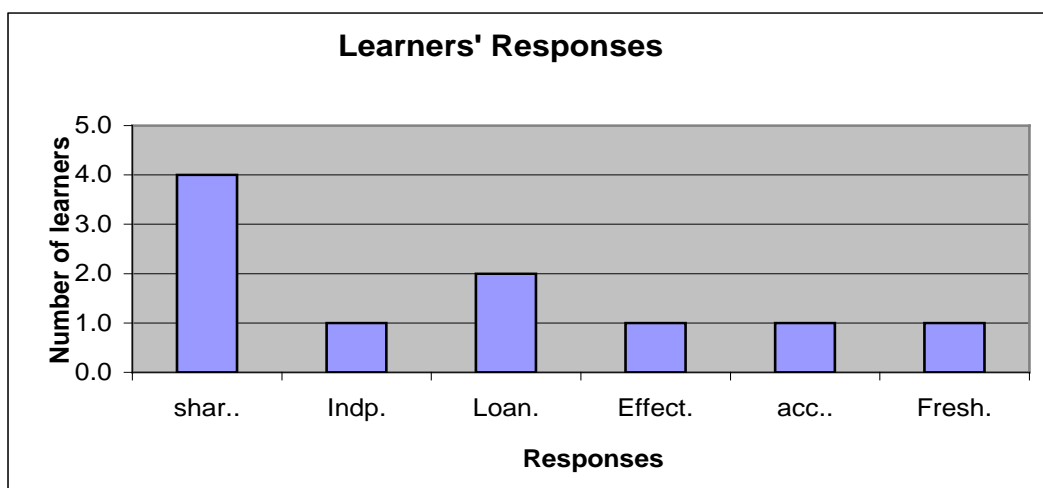


Figure 4: Learner's responses

Figure 4

Learners' responses in full:

Shar. Stands for *sharing* which means that EV promotes sharing of ideas in the learning environment.

Indp. Stands for *independence* meaning that EV promotes independence in learning.

Loan means that learners are able to *loan* EV materials and watch them in their own time.

Effect. Stands for *effective*, meaning that EV helps educators to teach effectively

Acc. Stands for *accessing* materials from other countries through the use of EV.

## **Classroom Observation**

The following issues were the focus of the classroom observation:

### ***The nature of the setting***

Classroom setup can dramatically affect students' attitudes toward learning. Students need an environment that is organized, stimulating, and comfortable in order to learn effectively. According to Jacob and Spiro (1995) a class setup should enable a teacher to move in between the learners; this helps to provide learners with the positive attitude of belonging. According to Jacob and Spiro, creating such an environment entails arranging a practical physical layout, supplying diverse materials and encouraging students to have a sense of belonging and ownership.

Jacob and Spiro (1995) argue that classrooms should be managed to encourage learners to be responsible for their own learning, to collaborate with other learners as a means of acquiring knowledge, to remain energized by their learning, and actively develop strategies for thinking and using the given materials.

### ***How the educator managed to refer to the learners' prior knowledge***

Students learn more effectively when they already know something about a content area and when concepts in that area mean something to them and to their particular

background or culture. When educators link new information to the learner's prior knowledge they activate the learner's interest and curiosity, and infuse instruction with a sense of purpose (Jacobson & Spiro 1995).

***How the educator engaged learners in the learning***

Educators should encourage discussion, opinions and cordial disagreement rather than only asking of questions. The focus should also be on how interactive the resource is to encourage the learner to think and explore the concepts and to ensure that the related learning task is sufficiently engaging to achieve the learning outcomes. According to Kearsley (1997) learners should engage with other learners in order for them to effectively construct knowledge

***Are the learners involved in activities that enabled them to acquire and construct knowledge***

Learning activities can play a crucial role in motivating learners to be actively involved in their learning Constructivist acknowledge that learning is an active, subjective and constructive activity (von Glasersfeld, 1995). Activities help learners to construct their own understanding on the concept.

***Does the teacher intervene by explaining, guiding and facilitating?***

Learning does not take place outside engagement. Walter (1998) postulate that the role of a facilitator is to guide summarize and monitor the class,

The researcher aimed at observing how the above aspects were performed in the class. Below are the results of the observation from both schools.

Table 3 represents the observation made:

Techniques	School A	School B	Comments
Nature of the setting	✓	✓	In both schools classrooms were organised. Learners were comfortably seated on chairs.
prior knowledge	×	✓	In school B educators linked the new knowledge with what learners already know. The linkage was well observed.
Learner's engagement	✓	✓	In both schools learners were engaged in activities. Tasks were done in groups. Learners' researched information discussed with each other and made conclusions.
Level of participation	×	✓	In school B learners' participation was high.
Educators intervention	✓	✓	In both schools educators intervene during and after presentation by emphasising important points of the lesson.
Activities	✓	✓	In both schools learners were actively involve in the given task, and this helped them to acquire the expected information.

**Table 3: Data from classroom interviews**

**Table 3**

(School (A) is Makintane High School; School (B) is Sekameng High School)

Table 3 represent data from classroom interviews, a tick indicates strength in the category, while a cross shows weakness in the category.

*Nature of the setting:* Both schools displayed a comfortable class setup where learners were arranged in such a way that are all able to watch presentations from the video without disturbance. The video was placed high enough for them to see clearly.

*Prior knowledge:* In school B (Sekameng High School) educators linked the new knowledge with the old one by probing questions, these was clearly displayed than in second school (see table 6). The known concept was used to lead to a new one.

*Learner's engagement:* In both schools learners were engaged in activities. This was observed during group discussion where all learners were given time to share to the colleagues. Tasks were done in groups. Learners work together to produce information used to construct conclusions which were reported to the class.

*Level of participation:* In school B participation was higher, they were more cooperative in their groups, they were discussing. And this enabled them to achieve at higher levels of understanding. Totten, Sills, Digby and Russ (1991) argue that shared learning gives students an opportunity to engage in discussion, and enable them to take responsibility for their own learning.

*Educators' intervention:* In both schools educators intervene during and after presentation by emphasizing important points of the lesson. Presentations were opened and learners were given a chance to ask or comment,

*Activities:* In both schools learners were actively involved in the given task, and this helped them to acquire a high level of performance. Learners were given activities from the known (simple) to the complex (new and more challenging)

## **Document review**

The following are the documents which were reviewed and their contribution in learning

### *Tests records*

Brown and Pendlebury (1997) assert that tests as part of assessment are an integral component of any successful teaching effort. Research has shown that students engage with subject matter based in part on their expectations about how their achievement will be evaluated. Educators who strive to bring authentic learning experiences to their students must plan appropriate and meaningful measures to assess student learning and mastery of concepts at hand. Test records of the two schools were reviewed to observe the improvement of learners' scores after the integration of video in mathematics teaching and learning.

### *Timetables*

If enough time is allocated for a subject allows learners to access sufficient information and consistent educational experiences to justify the award of a grade for the subject, learners are able to schedule practices and limit idling. The interest of the researcher was to understand the time allocated to mathematics lessons in the two schools.

### *Budget*

Educational institutions should have a budget which will enable the staff to adopt more technology into their learning environments the interest of the researcher was to observe whether the two schools have allocated some amounts of money for buying video equipments.

### *Technology Plan*

The role of technology plan is to indicate what kind of technology devices the school plans to buy and how they are going to be used. So the researcher wanted to understand whether there is a guide to improve the integration of technology in the two schools. As this would have great influence in the way educators use educational video in their teaching. The awareness of educators on the school goals in achieving improved technology integration serves as the motivation to implement the plan with the purpose of achieving the set goals and that if they experience problems, the schools have arranged plans to solve them.

### *Mathematics Syllabus*

The syllabi are used as a tool to provide a reliable guarantee of knowledge for a student that has passed a specific course. Resources are suggested in syllabi and they allow educators to plan their lessons more effectively (Larson, 2008). The interest of the researcher was to observe the resources used in teaching mathematics in grade ten syllabi. The video was observed to be an appropriate teaching tool in mathematics classroom in the two selected schools.

**Table 4: Availability of documents**

Documents	Makintane high school	Sekameng highschool	Comments
Tests records	×	✓	Record for a year could be found in Sekameng High school.
Time tables	✓	✓	In both schools time tables were available.
Budged	×	✓	At Sekameng High school budged for Technology is included in the Vision and Mission statements.
Technology Plan	×	✓	In Sekameng High school. Technology plan is included in the Vision and Mission statements.
Mathematics Syllabus	✓	✓	In both schools mathematics syllabus was used.

*Test records:* At Sekameng records were accessed and scores of the previous test were observed, though not consistent the difference could be identified that after the integration of educational video learners could score more than before.

*Timetables;* time-tables were available in both schools and were followed.

*Budget and Technology Plan:* Sekameng provided the researcher with the document of vision and mission statements where both Technology plan and Budget for technology devices are clearly stated. The only problem with this was that time allocated for the implementation of the plan was too short.

*Mathematics syllabus:* In both schools the syllabus is used; the fact which remains as a challenge is whether it being used effectively to meet its purpose

## **5.4 Interpretation of data**

### **5.4.1 Introduction:**

The intention in this section was to seek insights into the story behind the use of educational video in teaching and learning. As indicated in chapter three, the guided approach was used to collect data of this study; the interpretation of the findings was made based on the concepts of both Engagement and Activity theories as elaborated in chapter two of this study. The theoretical principles were arranged into four central themes, along with suitable categories. Data was discussed based on the scholarly ideas and opinions as well as researchers suppositions. This helped to conceptualize the conclusions and suggest recommendations from this study. The discussion was mainly from educators' interviews responses, data from learners' interviews, observations and documents were used to confirm findings from educators' interviews. The interviews were done in the class during break it took between forty five minutes and an hour.

**Table 5: Themes and categories**

<b>Themes</b>	<b>Categories</b>
Theme 1: Tools and artefacts used in teaching and learning of mathematics	Usefulness of tools and artefacts Learners motivation
Theme 2: Collaboration in technology integrated classroom	Discussion Engagement working in groups Peer learning
Theme3: Rules and Community in learning	Social relationship within the social community Learning groups
Theme 4: Hierarchical structure of	Learners' involvement Level of participation Educators' intervention Activity given to learners

#### **5.4.2. Discussion of results**

Data will be discussed using the themes and categories listed in Table 5.

See Figure 3 for the principles of the new theory used to guide this study.

#### ***Theme 1: Tools and artefacts used in facilitating teaching and learning of mathematics***

Activities are mediated by the tools used and the artefacts that impact on the thinking and experience during the performance (Vygotsky 1991). Vygotsky argues that an aspect of the mediation involved is that the tools and artefacts may help scaffold activities, making it easier for the activities to be undertaken and for the resulting outputs to be more significant in terms of range, content, quality and value.

Waltz's (2004) argument is that the use of tools in education could in some sense be seen as an engineering science where engineers are trained in artefacts design and in understanding and improving systems. They should be trained to understand that humans are part of systems. One of the question philosophies of technology deals with is what role does technology (artefacts) play in everyday human experience?" as a result approaches, and knowledge, from engineering science and philosophy of technology can contribute to the understanding and development of learning environments.

The way tools and artefacts are used in education provides background relationships, that is what learners can discern and thus learn. Through their use, certain concepts or features are brought to the fore, in other words, into students' focal awareness. Sferd and McClain (2002) argue that if one wants to understand why some curricula utilising classrooms are successful, but not others, must analyse the role of technologies in depth in each case.

When the use of technology becomes a focal point in the discussion, the ways of talking often shift from a closed form to a more open and explorative form, where the teacher is less prominent as expert and the dialogue takes on a more symmetric form (Karpov, & Haywood, 1998). The use of video in education was observed as an effective instructional tool appropriate for the students in the two Durban schools.

#### *Usefulness of Tools and Artefacts*

It is in this context that Bames and Brandon (1997) assert that the use of technology and multimedia improves instruction. Findings of their study indicated that the group of students which used technology in learning outperformed the non-users of technology on tests, scored higher in their assignments, applied more varied methods, used creative approaches to problem solving and were also active in classroom discussions. Dewey (2002) writes that video is an enriching and enhancing resource for classroom teaching and learning; it is focused, and helps to clarify abstract concepts. Data from educators' interviews indicate the usefulness of video in education. Some educators said "*video helps to present abstract concepts, saves time, and has helped learners to improve their performance in mathematics*" [The percentage of passes in mathematics has increased since the integration of video in the classroom], "EV helps when teaching abstract concepts" [like algebra].

Kellogg and Kersaint (2004) see video as a teaching tool which has the potential of stimulating imagination, offering a different perspective on or another approach to a topic. It connects learners with faraway places: for an example a video presentation can be recorded in America and viewed in Africa or vice-versa, and can also demonstrate abstract ideas, provide a common experience for all learners no matter the location, equalise educational opportunities and promote critical viewing skills and awareness.

An example here is of the lesson which was taught in one of the schools on Sequence and Progression. The video was used to present the three types of number sequencing, one of which is geometric progression, also known as a geometric sequence, which is a sequence of numbers where each term after the first is found by multiplying the previous one by a fixed non-zero number called the common ratio. For example, the sequence 2, 6, 18, 54... is a geometric progression with common ratio 3: similarly 10, 5, 25, 125... is a geometric sequence with common ratio  $\frac{1}{2}$ : The sum of the terms of a geometric progression is known as a geometric series. A second type of number sequence is arithmetic progression (A.P.) or arithmetic sequence, which is a sequence of numbers in which the difference of any two successive numbers of the sequence is a constant. For instance the sequence 3, 5, 7, 9, 11, 13 ... is an arithmetic progression with common difference 2. The third type of number sequence is the harmonic sequence: for instance, the sequence: 1,  $\frac{1}{2}$ ,  $\frac{1}{3}$ ,  $\frac{1}{4}$ ,  $\frac{1}{5}$ ... added together become the term of a harmonic series:  $1 + \frac{1}{2} + \frac{1}{3} + \frac{1}{4} + \frac{1}{5} + \dots$ . This series diverges (meaning that it has no finite sum).

EV was used to present the above concept and the following examples were presented in the lesson to enable learners to apply the concept in their daily activities: a soccer match, someone playing a keyboard, a growing flower and a cheers game. These would not have been easy to present in the lesson without the assistance of video, which made it possible for the learners to connect with instances outside the classroom. Video was useful to introduce these abstract concepts and also to bring objects from far places into the classroom. The teaching of the concept was successful because of the use of video.

A similar response from educators on the usefulness of the video was that “It also captures learner’s attention.” This response shows the usefulness of video in teaching

and learning in that learners are able to gain more when they are attentive. Other responses were, *“It helps when teaching abstract concepts”* (for example, a geometry lesson was observed where learners were dealing with practical problems involving complementary and congruent angles, angles formed when parallel lines are cut by a transversal, and angles of polygons – all of which were watched on the video). The video helped educators to introduce these topics more easily than using the lecturing method.

Learners seem to study well when the activities have an element of fun. One response that was recorded was *“It is a show, so learners view activities and this makes it easy for them to understand.”* Responses from learners’ interviews indicate that learners from both schools value the use of EV because it enables them to collaborate with other learners; some of the learners’ responses were, *“we share ideas with colleagues”*. And *“it helps teachers to teach mathematics effectively”*. ‘Video materials can be loaned and be watched at home and this also encourages concentration.

Dewey (2002) asserts that video prepares learners to harness the power of technology and use it as a tool to learn effectively. The level of participation of the learners in the two schools was high due to the strategies adopted in two schools. This strategy consists of three steps: pre-viewing activities, viewing activities, and post-viewing activities.

*Pre-viewing activity example:*

(In pre-viewing activities, learners are made aware of the amount of work they are going to be involved in and what the lesson is all about.)

In one example of a pre-viewing activity, learners at Sekameng High School were allowed to view (once or twice) an entire video unit about functions in advanced algebra where they were asked to fill in answers to the following questions:

What is the new topic?	
What background concepts do you need to know?	
What new concepts and processes do you anticipate learning?	
What questions do you have regarding the new content?	

*Viewing activity example:*

(1). Briefly answer the following questions as you view the video lesson:

- What background concepts do you need to know before attempting to a new concept?
- What questions do you have regarding the new concepts?

(2). Knowledge rating for unit on functions:

- How much do you know about the terms listed in the table?
- Place an x in the spaces that signal your knowledge

	A lot	Some	Not much
Functions			
Domain			
Range			
X intercept			
Vertical line test			
Horizontal line test			
Y intercept			

(3) My learning goals for this part of the semester are the following:

I will..... (A learner should reflect their study plan here)

In terms of studying I will spend .....each.....on studying and home work.

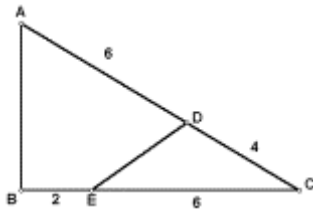
Learners were able to have a plan for their studies because they were aware of the effort needed for the new content. Bother (2007) writes that level of learners' participation is determined by the awareness that learners have on the objective of their curriculum. Bother (2007) further argues that the awareness of the lessons' goals motivates learners to use their free times to do class work in order to meet the tasks.

*Post-viewing activity example:*

(A post-viewing activity is one in which learners are asked to solve problems connected to the ones addressed in the presentation.)

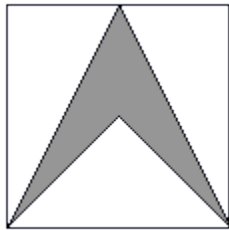
In the example given here the activity was an evaluation of the video lesson, where the aim was to check whether learners had understood the new content. A short test was arranged for the learners to work out after the geometry lesson.

1). Find the perimeter of a right triangle with shorter sides measuring 5 and 12 units.



2). In the above figure, the area of triangle CDE is 3 square units. Find the area of triangle ABC.

3). An arrow is formed in a  $2 \times 2$  square by joining the bottom corners to the midpoint of the top edge and the centre of the square



Find the area of the arrow.

Video was helpful to educators of the two schools in assisting them to adopt new strategies, such as the pre-viewing activity / viewing activity / post viewing sequence which has just been illustrated.

### *Motivation*

Ames and Ames (1989) argue that using video to capture skills being practiced by professionals in work settings will make student learning more concrete and lead to greater retention of information. Using video to enable an expert from the field to participate in class in some way is effective and motivates learners, leading to a high level of acquisition of information. The video is used as an active stimulus in instruction, and increases student motivation. Some responses recorded from learners were: “*It is a fresh way of learning*”; “*We don’t get bored easily with EV*” [learners were always busy in class due to their involvement in activities]. Felder (2003) writes

that verbal cues are effective at stimulating prior learning; videos, and other visual stimuli assist students in recalling prior learning much more effectively. If learners are not motivated it will be difficult for them to learn effectively, as Gardener (1985) points out when he writes that, without sufficient motivation, even individuals with the most remarkable abilities cannot accomplish their goals. The use of EV has gained popularity in teaching and learning due to live action, music, special effects and a sense of humour; it provides motivation to learners and this results in effective learning.

As indicated above, learners who are not motivated are unwilling to get involved in activities and various tasks; they lose interest and become more and more numbed or frustrated with their learning. EV as a tool in teaching and learning has proved useful in motivating the attention of learners in mathematics lessons. This is confirmed by de Brigard (1995) who asserts that technology affected peoples' style of living and the way they learn; learners really enjoy watching movies and video for a variety of reasons, and their interest in watching home videos and films can be exploited in the formal school system in teaching mathematics practices in a vivid and entertaining manner.

Felder (1988) postulates that video ensures motivated emotions which sustain learners throughout the lesson. This is confirmed by classroom observations where learners were observed to be actively involved: answering questions, participating in discussion groups, and sharing ideas according to their understanding,

Though learners are highly motivated with the video integration in mathematics classrooms in the two schools, educators, on the other hand, are experiencing challenges which hinder them from fully using video in teaching. The reasons are that some have never experience learning using video and still believe they are capable of using lecture methods in their presentations. McKenzie (1993) and Saye (1998) comment that some educators believe technology is just another educational fad, and will eventually pass like any other approach used in the education sector They still value their role as expert Another reason can be that they feel inadequate because of a lack of prior mastery of technology skills (Monahan, 1996 and Saye, 1998). This is confirmed by responses from educators where they indicated that, "The technical issues are still a problem..... Sometimes we don't know what to do when video does

not work properly during the lesson.” This interrupts and interferes with teaching processes.

Educators feel that they are not confident with the use of EV in facilitating learning of mathematics. Some revealed their lack of confidence in comments such as, “*We need a refresher course on how to use video to achieve the objective of the lesson.*” That video use is still a problem is confirmed by learners’ responses: “*Educators are not sure of how to use video and this impact negatively on our results in mathematics.*” Haddad and Jurich (2001) state that this inadequacy of skills on the part of educators creates misunderstanding between educators and learners in that the former have low skills in using EV making them reluctant to use it and develop technophobia (a fear of using technological devices), while learners, on the other hand, see educators as resistant to innovations which could help them learn mathematics. Responses from learners were that “educators are not sure of the use of technology and this impact negatively on our results in mathematics.” This gives evidence to the fact that most educators have low skills in technology use.

Considering the two categories above, it is evident that the use of EV in teaching and learning provides motivation and as a result has gained the popularity of being an effective tool in education, but the challenge is that educators lack skills to use video and they need to be empowered with skills to enable them to use EV in their instructions.

### ***Theme 2: Collaboration in a technology integrated classroom***

According to Cooper (1990), “collaboration learning” refers to methodologies and environments in which learners engage in a common task in which individuals depend on and are accountable to one another; it is where groups of students work together in searching for understanding, meanings or solutions or in creating an artefact of their learning such as a product. According to Johnson and Johnson (1986), collaboration refers to an instruction method in which students at various performance levels work together in small groups toward a common goal.

In the two schools, learners were observed being responsible for one another's learning as well as their own. The monitor of the group moved from one learner to the

other, assisting and explaining to those that did not understand how the answer was found. The sharing of ideas helps other learners to cope with the given task. Thus, the success of one student helps other students to be successful.

According to Johnson and Johnson (1986) proponents of collaborative learning claim that the active exchange of ideas within small groups not only increases interest among the participants but also promotes critical thinking, while Totten, Sills, Digby and Russ (1991) argue that there is persuasive evidence that cooperative teams achieve at higher levels of thought and retain information longer than students who work quietly as individuals. This suggests that shared learning gives students an opportunity to engage in discussion, take responsibility for their own learning, and thus become critical thinkers.

In the classes which were observed from the selected schools, learners were grouped and groups were given time to research, discuss and report. It was from the reports that other groups would critique the work of other groups, till the whole class came to consensus. This is in keeping with findings by Totten et al. (1991), who concluded that collaborative learning fosters the development of critical thinking through discussion, clarification of ideas, and evaluation of others' ideas. And that if the purpose of instruction is to enhance critical-thinking and problem- solving skills, then collaborative learning is more beneficial. According to (1978), students are capable of performing at higher intellectual levels when asked to work in collaborative situations than when asked to work individually. .

### *Discussion*

Experience and research indicate that discussion is an important component in learning, particularly in complex domains. Findings of Griffin and Case (1997) reveal that discussion is crucial for learning at all ages, that if very young children do not begin to make the connections between external representations and underlying concepts they can develop lasting problems, and that these connections are made through discussions.

Felder (2003) comments that discussion in learning serves as the thread that connects learners in collaborative community where they share ideas on the given problem as group members. He goes on to say that encouraging discussion, opinions and pleasant

disagreement promotes discussion in the learning environments. During classroom observations at Sekameng High School questions such as, “What have your experiences with this topic taught you?” or “What concerns you most about this topic?” were used to invite learners to discuss. Learners were divided into groups to discuss their experiences in the taught topic, and they were given time to share their experiences with the whole class. The researcher understood that variety is not just the spice of life; it’s an essential ingredient for learning. Balancing presentation with engagingly blended tools that stimulate all of the learners’ senses – embracing the visual, auditory, and kinesthetic dimensions of learning – is crucial because it stimulates critical thinking. As Felder (2003) points out, video is recognized to be a tool that caters for a range of learners’ learning styles. From experience of the researcher as an educator, passive listening and viewing do not generate learning.

Video can assist in delivering quality teaching and learning because images that are in motion help motivate learners’ attention and focus, opening up possibilities for collaborative teaching and learning in that learners are provided with a chance to participate in the discussion with other learners in the classroom and outside the classroom. It can provide “live” support for learners, especially during holidays and while at home doing their assignments and projects, because it can be watched at any time of interest to the learner. It also provides learners with opportunities to work with their peers from other institutions and countries, in other words it enables and supports collaboration among colleagues in their group work and international projects. Acker and McCain (1993) assert that EV serves as a medium for interaction between educators and learners in their teaching and learning.

### *Engagement*

Engagement theory emphasizes collaboration as an active strategy in facilitating learning. Engaging learners in as many ways as possible will help them give to and take from any learning experience to the fullest extent. According to Kearsley (1997), learners should collaborate with other learners in order for them to effectively construct knowledge. Learning does not take place outside engagement. Some of responses from educators were that “*Learners are engaged in their learning and they discuss in groups*”; “*After presentation learners are asked to form groups and write a report on what they have understood. Each group is asked to present its findings*

*and other learners asked questions*"; *"Learners are responsible for their own learning"*; *"Learners also become engaged in learning."* The engagement of learners was recognized during observation. Learners were involved in learning in both schools. They were given activities to solve problems, and if they got them wrong they were asked to review the presentation for the second time. This helped learners to correct themselves and see where they had missed something and could pick it up from there. Learners were given pre-activity tasks which indicated clearly what they should focus on during presentation. To support learners in this activity, the video would be stopped to emphasise important parts in the lesson. Learners were also asked questions to check whether they still follow the presentation; to show this, they were asked to indicate by raising a hand, to signify a problem or a question.

#### *Working in groups*

Sharing ideas, asking questions and solving challenging problems were the activities that learners were engaged in the schools visited; some educators said, *"EV enables my students to work in groups. With their friends...if there are not enough materials, learners can watch how it is being done on the video in class or at their own time"*. Educators indicated that EV encourages learners to work in groups: *"After presentation learners are asked to form groups and write a report on what they have learned. Each group is asked to present its findings and other learners asked questions."* This is confirmed by the results from observation where learners were observed to critique presentations of their colleagues; they were also observed asking and arguing on concepts on video presentations.

Where a learner did not understand, other learners helped with explanation. Hiebert and Wearne (1993) postulate that involvement and engagement of learners in learning enables high acquisition of skills. This is substantiated by Felder (2003) who affirms that 120 research studies indicated that group working in learning situations was considerably more effective than competitive or individualistic goals structures. Collaboration seems to have an impact in learning. During observation, some learners were stuck during activities and their colleagues explained the activity to them and they were able to catch up and started to participate,

Collaboration was encouraged in the classrooms that were observed; some of the comments educators made were: *"It enables my students to work in groups, with their*

*friends*”; “They collaborate with other learners.” This is in line with what Ellington and Race (1993) describe: those video materials can be used by groups as a way of facilitating the interaction of members of group in role-playing simulations and microteaching. Interactive video packages allow group discussion planning and provide responses directly. Small groups’ interaction helps learners succeed in the classroom. Promoting cooperation and collaboration provides much-needed opportunities for peer interaction as well as increased achievement. Wearne (1993) argues that group-work approach seem to be particularly appropriate with young adolescents because at this stage there is a preference for activity and interaction with peers during learning activities favourable for the development of high-level thinking. In promoting collaboration among learners, educators were observed allocating peer work, small-group work and letting learners work as the whole class. Learners were given tasks and asked to work in pairs, and at the end of the lesson they were asked to report their findings; other learners were given an opportunity to ask questions for clarity and give their views on the matter; after watching verbal problems presented on the video, pairs were given tasks.

One example given to peers involved the following: “A house contractor has subdivided a farm into 100 building lots. He has designed two types of homes for these lots: colonial and ranch style. A colonial home requires R300 000 of capital and yields a profit of R40 000 when sold. A ranch-style house requires R400 000 of capital and yields an R80 000 profit. If he has R36 million of capital on hand, how many of each type should he built for maximum profit? Will any of the lots be vacant?”

The video will help learners by presenting to them the two styles of houses, and from the presentation learners were able to differentiate and see that though ranch-style gives more profit when sold, it occupies more space, because one ranch-style house occupies the space that can be occupied by two colonial houses. These learners are able to conclude after the video presentation of the two styles of house that colonial style will be of greater benefit than ranch style.

Peers were expected to work on this problem to find answers and present each step of the process; after each presentation questions were allowed.

Video also provides learners with opportunities to work with their peers; in other words it enables and supports collaboration among colleagues in their group work, and it also serves as a medium for interaction in educators and learners in their teaching and learning (Acker & McCain, 1993).

### *Peer learning*

The use of EV promotes instructional methods involving active learning that present opportunities for students to formulate their own questions, discuss issues concerning their group work, explain their viewpoints, and engage in cooperative learning by working in teams on problems and projects. This is confirmed by Felder (2003) who argues that peer learning is a form of cooperative learning that enhances the value of student to student interaction and results in various advantageous learning outcomes. Educational video organises the collaborative processes which are devised to get all group members to participate meaningfully and actively in the given task (Roberts 1998).

Critique sessions, role-play, debates, case studies and integrated projects are other exciting and effective teaching strategies which are encouraged through the use of video in teaching, that stir students' enthusiasm and encourage peer learning. Students thus have diverse opportunities to experience, in a reasonably safe and unconstrained context (while perhaps being evaluated by another group and/or the educator), reactions to complex and real problems they may face later in their careers.

Roberts (1998) declares that peer learning promote effective learning in that it encourages team-building spirit and more supportive relationships; this element was observed in the two schools during data collection. Learners responded that: "*We share ideas with colleagues*" (See Figure 7 for learners' responses). And result in the greater psychological well-being, social competence, communication skills and self-esteem; higher achievement and greater productivity in terms of enhanced learning outcomes, responses from educators on this were " The integration of video in teaching and learning mathematics allow learners to work with other learners and educators from the class and other countries in the world (Learners can learn techniques practiced in other classrooms and places away from their own environment from video presentations).

During observation some learners were sick; and away from school, they did not understand the given task. Their colleagues explained the tasks to them and they were able to understand and started to participate. Sfard and McClain (2002) write that video can be used as a vehicle enabling learners to interact and collaborate with other learners in and outside the classroom. Interactive video package allow group discussion.

Considering the categories above it emphasized that the use of educational Video in teaching enhance sharing of information, Collaboration seems to have an impact in learning

### ***Theme 3: Rules and Community***

Roberts (1998) discusses the over-arching concept of involving the community in education. The degree of involvement offered through various activities in the schools promotes services that the community offers to both learners and educators, which can range from consultation to participation. This is where community experts can be invited to give services to the school as resource persons, or can be consulted to offer their knowledge on decision making. This enables a feeling of empowerment and ownership for the community. It is this degree of community involvement that provides opportunities for collaboration and partnering between government, school and the community. Roberts (1998) also suggests ways of involving community in educational institution that the community should be allocated roles and be asked to give their visions on the integration of EV into the curriculum, as these would promote their involvement and understanding of their importance in education. The consultation approach should be facilitated by providing full information about the Technology Plan so that the community could make informed decisions, and also by allowing the community to express a full range of views (without forcing consensus) in order to involve the community in the choice of a preferred option.

#### *Social relationship within the school community*

Vygotsky (1978) asserts that social interaction plays a fundamental role in the development of cognition. His model of teaching and learning, known as a 'social-constructivist model', emphasises that learners actively construct their own

knowledge by way of discussion, research, reflection, social interaction and interdependence in the development of their own thinking and learning, on a day to day basis.

According to Multisita (2001), ordinary ways of learning mathematics have proved to be in crisis, indicating that a possible solution could be the use of technology to facilitate learning for it enables interaction of school and community which consist of different parties: learners, educators, school administrations, parents and the Ministry of Education. With the use of EV learners connect with these community members to access information through presentations and literature. The absence of this means of interaction limits ways in which learners can consult. This is substantiated by some responses from the educators: for example, *“I enjoy facilitating my mathematics lessons through technological means to cater for individual difference.”* *But there is a need to have enough materials; “sometimes there are no videos for the lesson.”* Lack of material limits educators who find it profitable to use video in their mathematics lessons.

#### *Learning groups*

Learning groups include school systems, professionals, community and society. The community is comprised of one or more people who share the objective with the subject, such as different people that learners connect with in their learning, groups of learners, and educators. Learners’ learning concerns more than just the schools; it also embraces a chain of responsibilities of all members of community with their different roles contributing to build and nurture the development of a learner. Responses like, *“It enables learners to access materials outside the classroom”*, shows that learners do not learn in class only but also from the environment and all its inhabitants.

As indicated in the two categories above, there are not enough video materials to use in the two schools and this has shown to hinder their progress in using EV. The following responses indicated that there is limited video material in two schools: *“There are no videos for some topics in Grade 10 so I don’t use it that often”*; *“If the material was enough I would use it but there are no materials so I don’t use it regularly”*. This shows that there it is a need to add more materials, and this can be done through the help of other members of community. Since schools in South Africa do not have enough to buy all these materials, the community has a role to play in

pursuing funding strategies to provide the necessary technology for teaching and learning, professional development, technical support, equipment upgrades, and equipment maintenance that are needed to achieve educational goals. The urgent involvement of the community with strategies of fund raising and financial support is required to enable the quick integration of EV in the curriculum.

#### ***Theme 4: Hierarchical structures of activities***

Kearsley (1997) writes that engaged learning means that all student activities involve active cognitive processes such as creating, problem-solving, reasoning, decision-making, and evaluation. In addition, students are intrinsically motivated to learn due to the meaningful nature of the learning environment and the nature of activities given to them, whether they are achievable and authentic. Those activities should identify learning outcomes of the course. Learning outcomes should make clear to learners where they will be at the end of the course, should design learning opportunities, and should show what a learner can do. Kearsly (1997) concludes that learning outcomes should determine the level of the learners, and the specific knowledge. These activities should be realistic, and apply deconstruction appropriate to the level of the learner.

The classroom observations in the two selected schools have indicated that the sequence of activities given to the learners increased their level of participation in class. This is due to the strategies that were adopted from the EV presentations, of providing learners with three stages already mentioned: pre-viewing activities (where learners were made aware of the amount of work they are going to be involved in and what the lesson is all about, meaning the learning outcomes and activities that they will be involved in), viewing activities (where learners were encouraged to attempt some examples as they are presented), and post-viewing activities (where learners were asked to solve problems connected to the ones addressed in the video presentation). The awareness of the goals motivates learners to use their free time to do class work in order to meet the expected goals of the lesson. Botham (2007) writes that the level of learners' participation is determined by the degree of awareness that learners have of the objective of their curriculum. If learners are considerate of what is expected from them their participation is motivated.

### *Educators Intervention*

In both schools educators help learners during and after the lesson by answering learner's questions, emphasising main points, marking, and supporting those who fall behind. Educators intervene to help learning in mathematics classes, they become facilitators in classroom where educational video is integrated. Gilligan and Carter (2006) postulate that the role of a facilitator is to guide and monitor the class. Data from observation indicated that educators summarised key points of the lesson and guided the discussions in groups and in the whole class. They helped to manage a process of information exchange; they also helped with how the discussion is proceeding. Gilligan and Cater (2006) argue that educators' role is to introduce and involve learners in the committees and forums that design curriculum, to enable them to be acquainted with what they are presume to do.

### *Activities given to learners*

Learners were given activities which helped them link to the new learning; for example, the teaching of real analysis came before complex analysis. Engstrom (1999) argues that a hierarchical structure of activities affects the learner's understanding, meaning that learners should be introduced to the simple concepts before they commence with more complex activities. Tyre and Thomas (1996) advise that educators should present concepts logically so as to provide learners with stepping stones that lead them from the construction of less challenging tasks to more complex tasks. This enables learners to discover the link between concepts. It is also easy to use what learners already know as a basis for constructing the new knowledge. This was observed in the classrooms of the two selected schools, where learners were given a task to do as a basis for the new concept. For example, learners were asked to solve  $2x + 3y$  before solving  $px (z-xy) (z-y^2 + 2x8)$ , making it easier for learners to solve the second problem after attempting the first one. The same applies to teaching: deal with the simple concepts first and then move to more challenging concepts to enable learners to link the known materials to unknown,

Considering the three categories above emphasises that personalising learning, making learners co-creators of their learning, works for learners in that to achieve the objectives of the lessons they need to develop the confidence and skills to understand and manage their own learning.

Learners should be able to set out their long-term learning aims and, through regular reviews, shorter-term actions, and targets designed help facilitate successful achievement of those aims. Evidence suggests that learners do not always see the syllabus as something that helps them be informed about what is expected from them because its contents, actions and targets are not negotiated with them (learners).

Educators should develop a shared understanding of the learning process. They need to explore collectively what is considered as a good lesson and why – also to share and discuss this with their learners. This would include the importance of regular feedback, participation and active learning, so that when they intervene by facilitating in lessons, learners should know the contribution of their intervention. This will require support and training to facilitate this shift, and ensure that it improves the overall learning experience and outcomes for learners. The question is, are the educators and learners ready for these shifts? It is therefore urgent that preparation be structured for the two parties on this shift of functions.

### **5.4.3 Implications**

Findings of this study indicated that the integration of video in teaching and learning, appears to assist both learners and educators in the selected schools in South Africa. Educational video has proved to be a useful tool in teaching and learning environments. Educators have indicated its importance in teaching and that it enables them to present abstract concepts. This corresponds with Kellogg and Kersaint's (2004) observation that video as a teaching tool has the potential of stimulating imagination, and offers a different perspective on or another approach to a topic. It connects learners with faraway places in that video programmes from one country will be presented in another country EV also demonstrates abstract ideas. It provides a common experience for all learners no matter the location; for example, learners in Egypt could watch the same video lesson as the one being watched in South Africa and construct the same understanding, though in different locations. It equalizes educational opportunities for learners no matter the background. Educators from the two Durban schools have been found to be comfortable with its use in facilitating mathematics instruction. It enables authentic and higher order thinking in learners by engaging them in complex tasks within collaborative learning contexts.

There is a strong belief among educators at the two Durban secondary schools that the use of educational video in teaching and learning provides motivation in learners and this stimulus helps learners improve their scores in mathematics and has promoted collaboration among the learners and seems to enable learning through team or group working and peer learning. This promotes interaction and results in various advantageous learning outcomes. This is substantiated by Felder (2003) and Ellington, Percival and Race (1993), who write that video serves as a vehicle enabling learners to interact in groups' interaction and help learners succeed in the classroom.

Learners' involvement in their own learning was the issue which emerged from this study. It was observed that learners need to be involved in the planning of their curriculum; learners confidence and the skills to understand and manage their own learning, need to be developed. Bothan (2007) argues that learners' awareness and involvement in the designing of their curriculum motivates the level of participation offered by learners in their education; it also determines educators' intervention as facilitators and also the type of activities learners are engaged in.

Although EV seems to be valuable in teaching and learning in the two selected Durban schools , there are still discrepancies which need to be rectified to enable its effective use; these include issues of having partners to supply needed material, lack of facilities, practicing collaborative learning, professional empowerment, and preparation for readiness of learners in participating in curriculum designing.

## **5.5. Conclusion**

Henriquez and Riconscente (1998, p.58-59) argue that in a world increasingly interconnected by networks and dependent on knowledge, the interface between education and technology is vital. This corresponds with what has been said by Tinzmann (1998), and Scheffler and Logan (1999), who write that EV use tends to foster collaboration among students and bring changes in learning environments not present employed in traditional approaches where learners were passive and took in everything the teacher said, as opposed to active learning where learners are engaged in education through authentic learning through utilization of EV which brings dynamics into the classroom. Also explored in this study was the way EV is not transformative on its own: educators' guidance and intervention are imperative.

Evidence indicated that when used effectively, EV can support higher-order thinking by engaging students in real projects where learners collaborate with other learners on their search for the wanted information (Means, et al., 1993) rather than the focus being simply on the isolated individual learner. Means and Olson (1995) concluded that EV is one of a number of technological devices for sophisticated problem-solving and information-retrieving purposes.

According to Means and Olson (1995), activities given to learners, educators' intervention, and learners' participation in teaching and learning are all determined by an effective learner involvement in the designing and developing of their own curriculum, as these give motivation to both educators and learners because they are both aware of the requirement of the curriculum.

The recommendations that emerged from the data discussion will be elaborated in the next chapter.

## **CHAPTER SIX: Conclusion and Recommendations**

### **6.1 Introduction**

The analysis and interpretation of data in this study presented the need for certain measures to be implemented. It is the wish of the researcher to suggest measures which, if properly taken into consideration, would foster the purpose of this study. The chapter also sets out the theoretical framework that guided the study, the methodology used, the conclusions of the study, limitations of the study, the researcher's closing remarks and a summary of the findings of the study.

### **6.2 Theoretical Framework**

This study was informed by the constructionist ontology which assumes that for learning to occur learners should be left to construct knowledge, be involved, and be engaged in activities that involve cognitive processes such as creating, problem solving, reasoning, decision making and evaluation in order to achieve meaningful learning. Engagement and ctivity theories form the basis of this study. Engagement theory emphasises three principles of interaction in learning: “relate” – stressing interaction in the context of group activities (Kearsley, 1997); “create” – stressing the need for creativity to become the purpose of learning (Kuutti, 1996); “donate” – where provision of a meaningful setting for learning is implemented (Kaptelinin, 1996). Activity theory stresses collaboration and interactions within the activity system. It suggests that educators' roles should be to facilitate learning in the learning environment, should guide and provide support to the learners and should provide a hierarchical structure of activities. This means that activities given in class should be from known to unknown and learners should work with concepts that are simpler first so that they can apply skills that they have already acquired to attempt the new concepts, in order to allow effective learning. (Engestrom, 1987; Kuutti, 1996; and Kaptelinin 1996).

### 6.3 Methodology

The study adopted case study methodology. It concerns the use of educational video in facilitating learning of mathematics. The case of the use of EV to facilitate mathematics education in two high schools in Durban was studied in depth. This case study enabled the researcher to explore educators' experiences and to find in-depth data on how educators use EV in education. Case study helped to bring out details from the viewpoint of the participants by using multiple sources of data – for example through observations, documentation, and interviews.

Participants of this study were four educators and ten learners from grade ten in two high schools in Durban, KwaZulu-Natal, which use EV in teaching of mathematics. They were selected for the reason that they were accessible and available; they were also an appropriate group to give rich data on the use of EV in teaching and learning of mathematics.

### 6.4 Conclusion of the study

The study was undertaken to explore educators' perceptions, utilization and challenges experienced by educators in integrating Educational Video to facilitate learning of mathematics in two high schools in Durban, KwaZulu-Natal Province. This study answered some of the concerns and has developed other new concerns to be looked into in future. The study has also shown that educators value the use of EV and encourage other educators to use it in their own classrooms. The following are the critical questions, literature review and the findings of the study:

***Critical Question One: How do educators and learners currently utilize EV in teaching and learning mathematics?***

The literature indicated that video can be used in instructional situations to provide illustrative or supportive materials or as the vehicle by which an exposition or instructional sequence is presented (Ellington Percival & Race, 1993). According to Ellington Percival and Race, EV can be used in the mass instruction, some use it in individualised learning, while others use it in group learning. Sfard and McClain (2002) affirm that video can be used as an instructional tool for presentations to a

large number of learners. Video is suitable where motion needs to be demonstrated or where elements of the world outside need to be brought into the teaching and learning situation, to provide self-contained exposition that takes the place of a conventional lecture or taught lesson on a given topic.

Findings of this current study indicated that video is used to present abstract concepts for large groups of learners and to facilitate collaboration in the classrooms; also learners were given pre-viewing activity, where a segment of the video is selected to present a certain topic and learners are told what to watch in the selected segment. (See examples in table 3). During viewing activity questions were asked to make sure learners followed the presentation (see example in table 4). In post-viewing activity, learners are assigned tasks and projects to work on (see figure 2 and 3).

***Critical Question Two: What are the perceptions of educators on the use of EV in teaching and learning of mathematics?***

The literature shows that before integration of EV into teaching and learning educators were reluctant to use video in teaching but after training, their attitude changed and it is stated that thousands of educators appreciated EV and use it as an effective tool in teaching (Dewey 2002).

Findings of this study show that educators were comfortable with the use of EV in teaching for it enables learners to work in groups. Learners were engaged in their learning and discussed in groups. Observation indicated that abstract concepts were presented using video and were successful. After presentation, learners were asked to form groups and write a report on what they have understood.

***Critical Question Three: What challenges are faced by educators in using Educational Video in mathematics education?***

One of the challenges that educators were faced with was that they were encouraged to teach mathematics in ways that many of them have not experienced firsthand. As a result, they have to imagine a classroom they may have never witnessed; the consequences are that they revert to the traditional way of teaching which they were familiar with. They find it to be a challenge to divorce themselves from the teaching

methods they practiced for years and embrace the integration of video (NCTM, 1989, 1991, 2000). Cohen (1990) postulates that educators still have to acquire skills of using and selecting videos for the facilitation of the learning context, as well as creating achievable goals for learners' learning. This is what educators in the two schools experienced; they were unable to select the appropriate videos for the particular lesson.

Findings of this study illustrated that although educators were comfortable with the use of EV, the challenge was that educators still need to be empowered with technological skills. Learners' responses confirmed this: "Educators are not sure of the use of video and this impact negatively on our results in mathematics."

### **6.5 Limitations of the study**

Limitations of this case study were that the change or improvement brought by integration of educational video into teaching and learning of mathematics in two selected schools is subjective in the sense that those educators who do not want to change their approaches to the teaching of mathematics may have a different opinion from those that use EV and appreciate its impact on the learners' performance. Some educators may have their own interpretation which differs from the one that the researcher has; this subjectivity could be an uncertainty to other people (Wergin, 1992).

Lack of exposure on the part of both educators and learners in the use of EV in teaching and learning affected their competence and led to poor presentations. The failure to manage technological devices can lead to technophobia: a fear of handling technological devices.

On a number of occasions the interviewees were not available for interview sessions. In some cases they were committed to other duties and in other cases there would be lack of interest or the fear of judgment from the researcher. This delayed the process in that the researcher had to keep asking them. This affected the time scheduled for each interview session.

Case studies involve only a single individual or just a few and therefore may not be representative of the general group or population (Means & Olson, 1995).

## 6.6 Closing remarks

Botham (2007) argues that experience has a critical role in learning; learners come to the learning environments with different experiences that have much influence to the current classroom situation. Many learners today use technology in their homes and come to school already acquainted with technology like televisions, computers and videos; this has served as the way they access information, This study is of the opinion that curriculum designers should take into consideration the differences in learners due to the previous experiences they encountered, as advised by (Felder, 1988). According to Alexander, Higginson and Mogey (1999), the integration of video in education offers new pathways to learning; it encourages the emergence of higher-order thinking skills, and enables educators and learners to interact with real world resources in unprecedented ways.

Traditional educational practices no longer provide students with all the necessary skills for economic survival in today's workplace. Learners should be capable of applying strategies for solving problems and using appropriate tools for learning; they should not be restricted within the four walls of the classrooms but should collaborate and communicate with other learners (Ellington, Percival & Race, 1993). Today's learning environments should incorporate strategies and tools that prepare students for their futures. Children are educated to embrace their future to flourish in today's world and tomorrow's workplace,

None of these stated recommendations are sufficient or complete in and of themselves, but in combination they may be enough to make a substantial difference in more effectively promoting the integration of EV in education, which in turn should improve and enhance academic performance.

## 6.7 Summary of the Findings of the Study

### ***Theme1: Tools and artefacts***

The usefulness of tools and artefacts is that they help to buttress our activities, making it easier for the activities to be undertaken and for the resulting outputs to be more significant in terms of range, content, quality and value. This is confirmed by

Renyi (1996) who asserts that the use of EV improves instruction and demonstrates abstract ideas. Though video seems to be valuable to the learners, not all teachers are motivated by its use. McKenzie (1993) and Saye (1998) write that some educators believe technology is just another educational fad. They still value their role as experts. Another reason is that they feel inadequate because of low skills in using technology devices (Monahan, 1996; Saye, 1998). In order for the educators to be competent in using technology devices in education, they need to be empowered.

### ***Theme 2: Collaboration in the technology-integrated classroom***

Collaboration environments are where groups of students work together in searching for understanding, meanings, and solutions, and in creating an artefact of their learning such as a product (Cooper, 1990). Totten, Sills, Digby and Russ (1991) argue that there is persuasive evidence that cooperative teams achieve at higher levels of thought and retain information longer than students who work as individuals. The shared learning gives students an opportunity to engage in discussion, take responsibility for their own learning, and thus become critical thinkers. This coincides with Vygotsky's (1978) statement that students are capable of performing at higher intellectual levels when asked to work in collaborative situations. Collaboration in a technology-integrated class is encouraged by engaging learners in as many ways as possible; this would help them give to and take from any learning experience, as fully as possible. According to Kearsley (1997), learners should collaborate with other learners in order for them to effectively construct knowledge. Ellington Percival & Race (1993) write that video materials can be used by groups as a way of facilitating the interaction of members of the group in role-playing and in microteaching. This is supported by Felder (2003), who recommends 'peer learning' as a form of cooperative learning that enhances the value of student-to-student interaction. Educational video organises the collaborative processes which are devised to get all group members to participate meaningfully (Nelson, 1999). Nelson adds that peer learning promotes effective learning in that it encourages team-building spirit and more supportive relationships. Collaborative learning should be encouraged in the selected schools to enhance effective learning of mathematics.

### ***Theme: 3 Rules and Community***

Roberts (1998) argues that the community bears a responsibility for the involvement or engagement, in education of its learners. He further argues that the community should be allocated roles and be asked to give their visions on the use of technology in the curriculum, as this would promote their involvement and understand of their importance in education, creating a feeling of empowerment and ownership for the community. Furthermore, community involvement would provide opportunities for collaboration and partnering between government, school and the community. Involving the community in decision making helps promote social relationships within the school and community; these enable the community to support the schools with partners from the community who can supply or donate schools with material needed to enable integration of technologies in the curriculum.

### ***Theme: 4 Hierarchical Structures of Activities***

Students are intrinsically motivated to learn by the meaningful nature of the learning environment and activities, and these learning activities need to be authentic. There should also be progression from known to unknown activities to allow learners to use already known content to lead them to a new one (von Glaserfeld, 1995). On the other hand, Batham (2007) argues that learners get an activity correct because they know what was expected of them before tackling the activity. This learners' involvement technique of teaching worked better with the two selected schools than any other approach. Furthermore, when learners know what they are suppose to do before attempting a task; they work hard to meet the expected goal for they are part of it, unlike when they do not know what the educator's expectations are in the lesson. According to Botham (2007), learners should to be involved in the designing of their curriculum so that they are aware of the demand required by the curriculum.

Botham (2007) comments that an awareness of the goals motivates learners to use their free time to do classwork in order to accomplish the tasks. The educator's role is to introduce and involve learners in the committees and forums that design curriculum, to enable them to be acquainted with what they are expected to do. To meet these expectations, learners should be equipped and prepared for the new arrangement of being involved in the curriculum designing.

## 6.8 Recommendations

### *The need for partnership*

This study takes the view that all the stakeholders should be involved in the Technology Plan, which, when well structured, can serve as a road map to effective technology integration in a mathematics classroom. If stakeholders are involved in the planning this will provide financial support for the benefit of the learner to access the quality education, which would benefit all South Africans. This is a conclusion drawn from participants' responses, such as that *“There are not enough materials at the school. There are no funds to buy materials. Our school is poor....”* *Though the principal is trying to give appropriate financial support, the problem is that the school does not have enough money to cater for the necessary technologies”*.

The use of video in teaching in the two selected schools needs to be supported with funds for additional technological materials such as video cassettes and monitors. Inadequate funding results in poor mathematics instruction in the classrooms, and hence poor mathematics results in the whole country. This report is of the opinion that video materials should be provided to enhance the integration of technology in schools to accommodate the student population in the classrooms. This can be done by finding partners from the community, such as business people who can provide the schools with video materials and maintain materials as well as supplying new and modern equipment to replace what is old and expired.

Data from the documents review indicated that there is a need for technological budget which will allow the schools to buy more technological devices to promote the use of EV in schools. According to Bailey and Pownell (1998), without financial support technology integration in the classroom will never be satisfactorily achieved. General shortage of technology equipment and other essential learning facilities in mathematics classrooms contributes to the poor results which South African schools are experiencing at the moment (Lubisi & Cronje 2007).

### *The need for collaborative learning*

Collaborative learning refers to an instruction method in which students at various performance levels work together in small groups toward a common goal (Acker, & McCain, 1993). Collaboration enhances acquisition of information where a learner

does not understand something and other learners help with explanation. It is substantiated by participants' responses that sharing of ideas in learning promotes effectiveness of learning. Examples of responses from the educators were: "Each group is asked to present its findings and other learners asked questions"; "*EV enables my students to work in groups with their friends.*" In collaboration learning, learners are responsible for one another's learning as well as their own. Thus, the success of one student helps other students to be successful (Johnson and Johnson, 1986). Ellington and Race (1993) argue that group-work approach seem to be particularly appropriate with young adolescences because at this stage, they prefer active interaction with peers during learning activities. Educators and learners should be in a position of sharing ideas as this helps them to learn effectively. Staples (2008) write that collaboration promotes conceptual understanding; students have an opportunity to share their thinking, consider alternate conceptions and discrepancies and making sense of various presentations. Collaboration should be enhanced in mathematics classroom to enhance the absorption of concepts.

#### *The need for staff empowerment*

From the responses of the participants, most educators have heard with dismay stories about equipment failure and did not know what to do, They don't want to be left hanging with more than 80 students wondering why things are not working the way they are supposed to be. "We need a refresher course on the use of video to achieve the objective of the lesson"; "*The technical issues are still a problem, sometimes the video gets stuck and we don't know what to do.*" These were some of their responses. When educators are trying to use technology in their classrooms and they encounter difficulties, they need immediate help and support. Although it is clear that developing new approaches through the use of technology strategies to quantify teaching and learning outcomes will require more time and funds, the demand needs to be addressed. "*We need a refresher course on the use of video to achieve the objective of the lesson. The technical issues are still a problem.*"

Equipping technology users with skills to be actively engaged with technology at their work location is probably the most meaningful, essential and appreciative support that can be provided, advises Brody (1995, p. 137).

Educators should be empowered with technological skills that will enable them to integrate technology in mathematics classrooms, as this allows a variety of teaching strategies that will help educators to implement more appropriate approaches to suit their classrooms. These strategies include engaging with outside sources or experts which will motivate student progress in mathematics,

These can be enhanced by school-based workshops where educators will share the challenges they encounter when implementing the use of video, and can find solutions among themselves. From school-based workshops they can establish regional training of teachers by experts; this should be where educators from each region meet to be trained on the use of technology in teaching and learning. Renyi (1996) writes that changing roles and responsibilities of educators in the classrooms where they must now become facilitators require training, especially for mathematics teachers, to enable them to use methods for designing instruction and accommodation for learners with different learning styles. Educators need time to acquire technology skills and develop new teaching strategies for integrating technology into the classroom; administrators should provide support for professional development by funding them to undertake training. This can be done during holidays and could establish a truly collaborative atmosphere within schools in which professionals can share resources; that will help them provide effective classrooms and higher academic learning-time ratios.

#### *The need to prepare for readiness of learners*

The participation of learners from the two selected schools increased when pre-viewing activities were introduced. The classroom observations indicated that the reason for this was that learners were made conscious of what was expected of them, and as a result they participated with the aim of achieving those set objectives of the lesson. A substantial review and reform of the secondary curriculum is required to accommodate learners' views.

Learners need to be adequately prepared for them to be able to make the kind of input to the curriculum design that would develop confidence in them to manage their own learning. All learners should be able to set out their long-term learning aims and, through regular reviews, shorter-term actions and targets designed to facilitate successful achievement of the curriculum aims. Evidence suggests that learners do

not always see the syllabus as something that helps them be informed about what is expected from them. This is because its contents, actions and targets are not negotiated with the learners. Botham (2007) argues that the awareness and involvement of learners in the designing of their curriculum motivates the level of participation offered by learners in their education; it also determines educators' intervention as facilitators, and also the type of activities learners engaged in. The question is whether educators and learners are ready for this shift, where two parties have to discuss and set curricular outcomes with learners and assess whether the lesson presented was a good one or identify its shortcomings. Both learners and educators need to be prepared to enable them opt for this task. This can start with school-based forums, leading on to regional, district and provincial forums, where recommendations are made on what to learn and at which level.

## **6.9 Conclusion**

There are still challenges waiting ahead as far as integration of educational video in teaching and learning is concerned. More research needs to be undertaken in order to approach the learning activities with success. Considering the categories above it must be emphasised that the use of educational video in teaching to enhance sharing of information and collaboration does seem to have an impact in learning, Further research on the integration of educational video in teaching and learning is still needed in order to understand its importance in the curriculum and to unlock the traditional approach and admit a learner-centered approach where learners construct their learning through collaboration, project-based learning and authentic learning (Kearsley, 1997).

This last chapter of the study presented the conclusion of the study, the closing comments and the findings. Suggestions which were drawn from the data discussion were elaborated. It is hoped that the effective use of video and video conferencing in mathematics teaching will improve learning of the subject. In this study it was shown that using videos to teach mathematics is beneficial, especially in the light of the large number of pupils in the rural areas as well as teachers who may not be qualified as aspects in mathematics teaching.

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## Appendix A

### **INTERVIEW SCHEDULE FOR EDUCATORS**

**This section serves to find the background of the educator**

- When did you qualify as a teacher?
- Which subjects do you teach in Grade Ten?
- How long have you been in the school?

**The aim of this section is to find how educational video is used in the learning and teaching of mathematics.**

✚ Responses of the following questions are expected to answer critical question one.

- In what way does Educational Video help you as an educator to facilitate learning of mathematics?
- How do you rate the impact of Educational video in your teaching in terms of your learner's performance?
- To what extent Does EV contribute in improving learner performance in mathematics education?

✚ Responses are to answer critical question two

- How often do you use Educational Video as a teaching and learning mediator in your Mathematics lessons in grade Ten?
- Is there any improvement of teaching and learning of mathematics since the integration of EV?

✚ Responses are to answer critical question three.

- What challenges do you encounter in integrating Educational video in the classroom?
- What kind of support do you get from the school towards these challenges?

## **Appendix B**

### **INTERVIEW SCHEDULE FOR THE LEARNERS**

#### **To answer critical question one:**

- How does EV help you to improve your assimilation of mathematics education?
- In what way does Educational Video help both you and other students in learning Mathematics?
- How do you rate the impact of integration of Educational video in learning, in terms of your performance?

#### **To answer critical question two:**

- When did you come to the school?
- When did you start using video for learning?
- When did you first use Educational Video to learn Mathematics education?
- How often do you use Educational Video as a learning mediator in your Mathematics lessons?

#### **To answer critical question three:**

- What challenges do you encounter in using Educational video in learning of Mathematics?
- What kind of support do you get from educators towards these challenges?

## Appendix C

### Observation schedule:

Teachers Name-----

Date-----

Venue-----

Lesson No-----

Approximate duration of the lesson-----Minutes

The schedule is to be completed by the researcher while or after the lesson. The researcher will show by using M, S, and N on the relevant space, and comment where necessary.

Code M=most of the time

S= sometimes

N= not at all

#### 1. The clarity of the Video

a) Pictures clear-----

b) The sound clear-----

c) The volume appropriate-----

#### 2) Did the educator assist

a) Secure students attention-----

b) Promote learners focus-----

c) Use EV to promote link to previous session-----

d) Appropriate and effective use of EV was used to support  
Teaching-----

#### 3) Employ small group/pair work-----

#### 4) Keep students involved-----

#### 5. Give support and guide-----

6. Critical thinking and analysis was modeled and encouraged-----  
 ---
8. Encourage student's discussions-----
9. Encourage students to answer difficult questions-----
10. Support lessons with useful classroom discussions and  
 activities
11. Does EV used in mathematics lesson
- a) To promote authentic learning-----
  - b) To promote project engagement-----
  - c) To encourage individual involvement-----
  - d) To engage learners in activities-----
- 12) Indicate the type and extent of learner involvement during the  
 lesson.
- a) Writing of notes-----
  - b) Ask questions-----
  - c) Answer questions correctly-----
- 13) Most of the learners participate actively in the lesson-----
- 14) Educators intervene to emphasize important points during the  
 Lesson-----
- 15) Do educators and learners face challenges in using EV in  
 Classroom-----
16. Do educators and learners get assistance from the administration  
 of  
 The school when needed-----
17. The learners are given activities during and after lesson-----

## Appendix D

University of KwaZulu-Natal  
Edgewood Campus  
Rosewood Flat 2  
Room 73  
February 13, 2008

The Principal

Durban

Dear Sir/Madam

### **Re: Permission to conduct a study**

I am a Masters of Education student at the University of KwaZulu-Natal, specializing in Educational Technology. I am undertaking a study as a fulfillment of the requirement for the degree of Masters in Education.

My study is on “The use of Educational Video to facilitate learners’ performance in Mathematics Education in grade ten” (or any other grade). The purpose of the study is to ascertain educators and learners’ perceptions about the use of EV in the classroom, and investigate into how educators utilize Educational Video in the classroom in facilitating learners’ performance in Mathematics Education and the challenges they encounter in using Educational Video.

The need for the study is to assist the researcher to develop concern on the use and impact of educational video in teaching and learning, how educators make use of integration of Educational Video in their classrooms to improve teaching and learning.

The study will help educators’ trainers in developing them with skills of using technology to improve teaching and learning. Since there is not enough literature in South Africa on the use of video in teaching Mathematics, the study could be used to add value to the literature on the use of Educational Video in teaching and learning Mathematics.

In the process of data collection the researcher intends to engage in interviewing educators and learners which will be audio recorded, observe lessons which will be video recorded and review documents e.g. tests records, learners' work books, and progress reports to find the previous performance of the learners, in order to explore the impact of the use of educational video. The collection of data is anticipated to take place between the month of April and May 2008. After the analysis of data the educators and learners will be invited to comment on the findings to reflect on their experiences.

The real names of schools will not be used at any point of information collection, or in the written case report; instead, for the school, educators, learners, other persons and places names, pseudonyms will be used in the final write-up.

I would therefore highly appreciate your support in as far as allowing educators and learners to participate in such a study.

**Please take note of the following issues:**

1. Participation is voluntary, and participants are free to withdraw anytime when they feel like. Refusal to participate will not have negative consequences on them.
2. The information provided by participants will be kept, as confidentially as possible between the researcher and the participant.
3. Participant identity will under no circumstances be disclosed.
4. All participants in this study will be acknowledged and be thanked.
5. The data collected will be kept and stored in a secure venue. After the submission of the thesis the data will be stored in the School of Education Studies Faculty of Education for a period of five years, afterwards this can be destroyed.
6. In completion of this study, the researcher intends to provide the school with the rectified document which indicates strengths and weaknesses encountered during the study, and recommendations which indicate how the weak points can be improved.

7. If you grant permission for audio recoding and video taping no audio and video tapes will be used for any purpose other than to do this study, and will not be played for any reason other than to do this study. After the submission of the thesis the data will be stored in the School of Education Studies Faculty of Education for a period of five years, after that the information can be destroyed.

The study is supervised by Mr. S.B.Khoza whom you can contact at 0833111468 or e-mail him at [khozas@ukzn.ac.za](mailto:khozas@ukzn.ac.za) at the University of KwaZulu–Natal. And co-supervisor

Dr. Irene Govender whose contact details are as follows: Phone no. 0312603485 or you can e-mail her at [govenderi4@ukzn.ac.za](mailto:govenderi4@ukzn.ac.za),

My Cellular phone is 0735751430, my email is [magy@ukzn.ac.za](mailto:magy@ukzn.ac.za)

Your positive response is highly considered.

Yours faithfully

‘Malerato Sebolelo Ncheke

**Please fill the consent form below by ticking the appropriate response:**

I have been given information about the research project, and it has been explained to me how the given information will be kept confidential, and that the School identity as well as of educators and learners will be protected when the researcher uses the information provided to her. [Yes] [No]

I conform that I have read and understand this consent document.

[Yes] [No]

I agree to offer the researcher an opportunity to conduct a study in my School.

[Yes] [No]

-----  
**Signature of principal**

-----  
**Date**

## Appendix E

University of KwaZulu-Natal  
Edgewood Campus  
Rosewood Flat 2  
Room 73  
October 2007

Dear Parent

.....

Durban

South Africa

Dear Sir/Madam

### **Re: Permission to engage your child in the study**

I am a Master of education student at the University of KwaZulu-Natal, specializing in Educational Technology. I am undertaking a study as a fulfillment of the requirement for the degree of Masters in Education.

My study is on “The use of Educational Video to facilitate learners’ performance in Mathematics Education in grade ten”. The purpose of the study is to ascertain educators and learners’ perceptions about the use of EV in the classroom, and investigate into how educators utilize Educational Video in the classroom in facilitating learners’ performance in Mathematics Education and the challenges they encounter in using Educational Video.

The need for the study is to assist the researcher to develop concern on the use and impact of educational video in teaching and learning, how educators make use of integration of Educational Video in their classrooms to improve teaching and learning.

The study will help educators' trainers in developing them with skills of using technology to improve teaching and learning. Since there is not enough literature in South Africa on the use of video in teaching Mathematics, the study could be used to add value to the literature on the use of Educational Video in teaching and learning Mathematics.

In the process of data collection the researcher intends to engage in interviewing educators and learners which will be audio recorded, observe lessons which will be video recorded, and review documents e.g. tests records, learners' work books, and progress reports to find the previous performance of the learners, in order to explore the use of educational video. The collection of data is anticipated to take place between the month of April and May 2008. After the analysis of data the educators and learners will be invited to comment on the findings to reflect on their experiences.

I would therefore highly appreciate your support in as far as allowing your child to participate in such a study.

**Please take note of the following issues:**

1. Participation is voluntary, and participants are free to withdraw anytime when they feel like. Refusal to participate will not have negative consequences on them
2. The information provided by participants will be kept, confidentially between the researcher and the participant.
3. Participant identity will under no circumstances be disclosed.
4. All participants in this study will be acknowledged and be thanked.
5. The data collected will be kept and stored in a secure venue. After the submission of the thesis the data will be stored in the School of Education Studies Faculty of Education for a period of five years, afterwards this can be destroyed
6. The real name of your child will not be used at any point of information collection, or in the written case report; instead, the school, educators, learners, other person and place names involved in the case will be given pseudonyms that will be used in all verbal and written records and reports.

The study is supervised by Mr. S.B.Khoza whom you can contact at 0833111468 or e-

mail him at [khozas@ukzn.ac.za](mailto:khozas@ukzn.ac.za) at the University of KwaZulu –Natal. And co-supervisor

Dr. Irene Govender whose contact details are as follows: phone no. 0312603485 or you can e-mail her at [govenderi4@ukzn.ac.za](mailto:govenderi4@ukzn.ac.za),

My Cellular phone is 0735751430, my email is [magy@ukzn.ac.za](mailto:magy@ukzn.ac.za)

Your positive response is highly considered.

Yours faithfully

‘Malerato Sebolelo Ncheke

**Please fill the consent form below by ticking the appropriate response:**

I have been given information about the research project, and it has been explained to me how the given information will be kept confidential, and that the names of learners will be protected when the researcher uses the information provided to her. [Yes]  
[No]

I conform that I have read and understand this consent document.  
[Yes] [No]

I agree to offer the researcher an opportunity to engage my child in the study.  
[Yes] [No]

-----  
Signature of parent

-----  
Date

## Appendix F

University of KwaZulu-Natal  
Edgewood campus  
Durban.

10 November 2007

Dear participant,

I am a Master of education student at the University of KwaZulu-Natal, specializing in Educational Technology. I am undertaking a study as a fulfillment of the requirement for the degree of Masters in Education. My study is on “The use of Educational Video to facilitate learners’ performance in Mathematics Education in grade ten”. The purpose of the study is to ascertain educators and learners’ perceptions about the use of EV in the classroom, and investigate into how educators utilize Educational Video in the classroom in facilitating learners’ performance in Mathematics Education and the challenges they encounter in using Educational Video.

The need for the study is to assist the researcher to develop concern on the use and impact of educational video in teaching and learning, how educators make use of integration of Educational Video in their classrooms to improve teaching and learning.

The study will help educators’ trainers in developing them with skills of using technology to improve teaching and learning. Since there is not enough literature in South Africa on the use of video in teaching Mathematics, the study could be used to add value to the literature on the use of Educational Video in teaching and learning Mathematics.

In the process of data collection the researcher intends to engage in interviewing educators and learners which will be audio recorded, observe lessons which will be videotaped, and review documents e.g. tests records, learners' work books, and progress reports to find the previous performance of the learners, in order to explore

the use of educational video. The collection of data is anticipated to take place between the month of March and April 2008. After the analysis of data the educators and learners will be invited to comment on the findings to reflect on their experiences. I appreciate the time and information you intend to give for the success of this study.

**Please take note of the following issues:**

1. Answer all the questions.
2. Respond to each question in a manner that will reflect your own personal opinion.
3. The information from the participants will be kept confidential and will not be used for other purposes except this study.
4. Participation in the study is voluntary. Participants are free to withdraw from the study at any time for any reason. Refusal to participate will not have negative consequences on you.
5. There is no right or wrong answers.
6. Confidentiality of responses will be highly considered

This study is supervised by Education Technology lecturers at University of KwaZulu- Natal Mr.Bheki Khoza, Tel: (031) 260 7595, Cell: 083 3111 468, Email: [khozas@ukzn.ac.za](mailto:khozas@ukzn.ac.za). and

Dr. Irene. Govender, Tel: (031) 260 3485, E-mail [Govenderi4@ukzn.ac.za](mailto:Govenderi4@ukzn.ac.za)

Thank you for your support, and co-operation of your valuable time.

Malerato Ncheke

M. Ed. Student at the University of KwaZulu Natal

Tel: 0735751430 Email: [magy@webmail.co.za](mailto:magy@webmail.co.za)

**Please sign the following declaration and include your full names as indicated.**

**DECLARATION FORM**

I----- (full names of participant)

Hereby conform that I understand the contents of this document and the nature of the research project, and I consent to participate in the research project.

I understand that I am at liberty to withdraw from the project at any time. Should I so desire

-----  
Signature of participant.

-----  
Date