

**THE EFFECT OF TECHNOLOGY ON ATTENTION AND CONCENTRATION WITHIN
THE CLASSROOM CONTEXT**

by

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I declare that: "The Effect of Technology on Attention and Concentration within the classroom context is my own work and that all the resources that I have used or quoted have been indicated and acknowledged by means of complete references".

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life.

Thank-you for your continual support, guidance and love.

You truly are my inspiration.

I will love you and miss you forever.

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SUMMARY

The main objective of this study was to determine the effect of technology on attention and concentration within the South African classroom.

The theoretical investigation showed the link between focus, attention and concentration. It also revealed the importance of motivation in order to capture the attention of the learner in the classroom. The life-world of the learner is often far removed from the classroom learning context.

During the empirical investigation, lessons were conducted with and without the presence of technology in order to ascertain whether a difference in attention and concentration would elicit different results. An ANOVA procedure indicated that there is a significant difference between the average achievements of a group of learners exposed to technology during a lesson, compared to a group not exposed to technology; there is a significant difference between the average attentions of a group of learners exposed to technology during a lesson compared to a group not exposed to technology; there is a significant relationship that exists between motivation and concentration; and that a significant relationship exists between motivation and attention in Mathematics.

Keywords: attention, concentration, focus, technology, motivation

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1. ORIENTATION, PROBLEM ANALYSIS AND THE RESEARCH PROGRAMME

1.1 INTRODUCTION

I sometimes worry about my short attention span, but not for very long!

Strange de Jim

Essentially classroom teaching consists of a teacher who teaches and learners who learn. The simplicity of this relationship is influenced by a number of factors, both external and internal, which affect the significance and excellence of the teaching and learning. The amount of time and effort spent in a classroom, however, is worthless unless the learners are learning. This is manifested within the concentration span in a classroom.

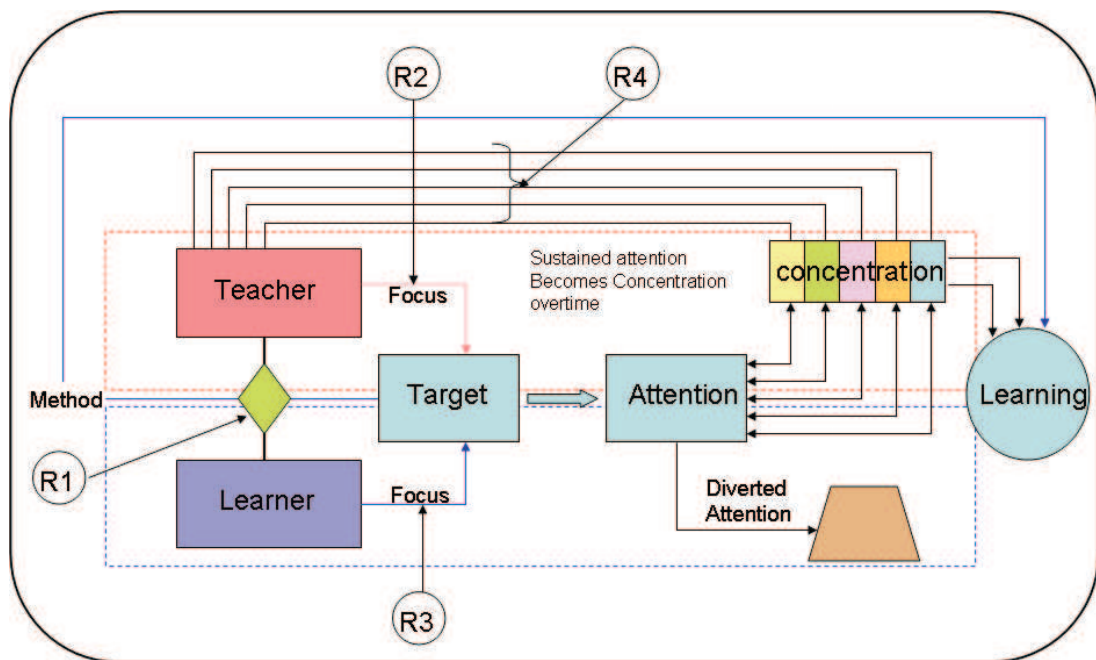


FIGURE 1.1: LINKING ATTENTION AND CONCENTRATION

Referring to figure 1.1, a relationship (R1) exists between the teacher and the learner. This relationship is targeted at learning. In order for this learning to take place, the

teacher makes use of a method of focussing the learner's attention on the target. Focus is seen here as zoning the learner's attention on the specific pre-chosen target in order for attention to occur. A relationship (R2) therefore exists between the teacher and the target with the aim of leading to a relationship (R3) between the learner and the target. When the learner shifts his/her focus correctly on the intended target, his/her attention is captured. This attention, when sustained over time develops into concentration. (See paragraph 1.2 for definition of concepts).

However, as can be seen in figure 1.1, this concentration can be lost at any time in which case it diverts back to attention (symbolised by the double arrowed lines) which is then focussed elsewhere on a new target. This target is often not the one intended by the teacher. The teacher therefore needs to continually focus the learner back on the required target (R4). If the learner's attention is focussed on the required learning material, and the learner maintains this focus of attention, over a period of time, this prolonged or sustained attention is concentration. Tsang, Kwan and Fox (2007: 12) state that meaningful learning can be achieved as long as one of three forms of interaction (student-teacher; student-student; student-content) is at a high level.

If however, as already mentioned, a learner's attention may wander and he/she may focus attention on a new target, the learner fails to concentrate on the chosen learning material and intended learning may not therefore be effective. In today's world, teachers have found that using computers or computer-related technologies can capture and hold students' attention (Shelly, 2004: 6.11).

The critical factor in the learning process, according to Hale and Lewis (1979: 33) is attention. Unless the attention of the learner is captured and is optimal, the learning is

minimised even though the teaching may continue. The teacher and learners need to work together efficiently, with each attending to the learning situation in an active, selective fashion.

Education has changed radically over the past century. It can best be described as having evolved from the Agricultural Age to the Industrial Age to the Information Age. The illiterate of the twenty-first century will not be those who cannot read and write, but those who cannot learn, unlearn and relearn (Toffler, 1980: 207; Niess, Lee & Kajder, 2008: 75). Education today is not, however, focussed on the learner recalling and regurgitating facts but rather on the accessibility of these facts and on easy access to the required material.

Today's learners rely to a great extent on visual learning. Literature from educational research supports the claim that using visuals in teaching results in a greater degree of learning as the learners seem to concentrate better and for more sustained periods of time, according to Ainsworth and Loizou (2003: 675) as well as Sims, O'Leary, Cook and Butland (2002: 129) visuals help to capture and maintain one's attention. Bitter and Legacy (2008: 23) also point out that learners would retain more information with the help of sufficient visual content in their learning materials. Many students today are visual learners having been brought up in a world of technology, so without visuals in a presentation the learners may not learn (Smaldino, Lowther & Russell, 2008: 259).

In today's instant world, where people are used to ongoing stimulation in order to attract attention and continued stimulation in order to maintain concentration, does the classroom setting and environment still optimise the learner's concentration? So many of today's learners from advantaged homes and families are not interested in learning or

are not motivated to achieve (Barr & Parrett, 2008: 6). Are learners of today stimulated purely by technological gimmicks or are traditional attention seeking methods still relevant in the classroom setting? The question is, do learners of today concentrate optimally in the classroom and if so, what is it that attracts their attention best and allows them to concentrate? Despite their role as innovators, teachers have always had a love-hate relationship with technology (John & Wheeler, 2008: 15), many trying to stay up to date with the latest trends and innovations.

Motivating students to learn is one area that all educators are constantly trying to achieve. Many teachers who do not have today's technology at their finger-tips and who are not privileged to work in schools equipped with technological resources, are often at their wits end to motivate learners. Technology has the potential to increase student motivation and class attendance (Shelly, 2004: 6.08).

1.1.1 Dynamics of Today's Learning Environment

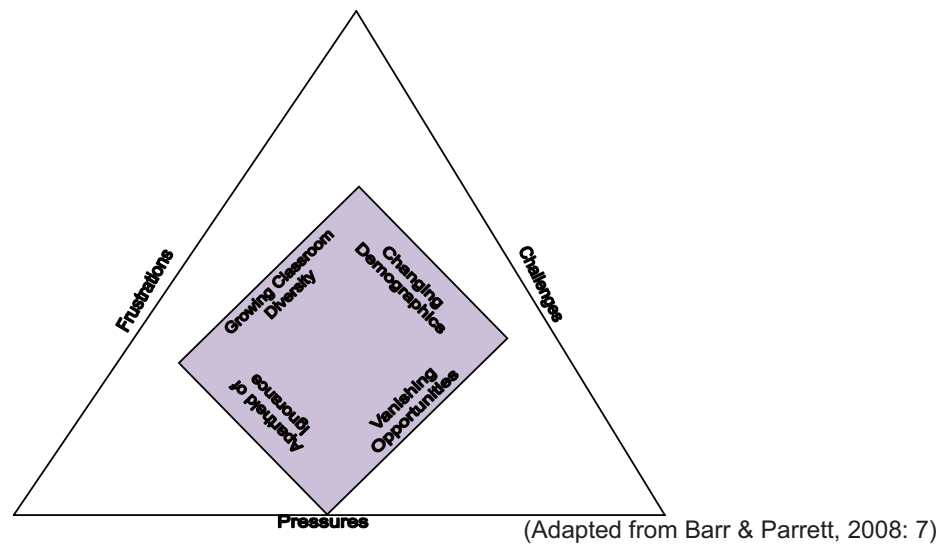


FIGURE 1.2: DYNAMICS OF TODAY'S LEARNING ENVIRONMENT

Figure 1.2 is a representation of the dynamics that exist in schools today. In classrooms teachers are dealing with learners who live in today's society and therefore

figure 1.2 can be interpreted as the pressures, frustrations and challenges faced by the teacher in today's 21st century classrooms. These challenges include teachers remaining on the brink of technology. This is a dynamic and continually changing sphere which has become an integral part of the learners' world. Teachers need to remain ahead of the educational technology world in order for learners to remain motivated to learn. Once they are motivated sufficiently, it is necessary to capture their attention and maintain their concentration.

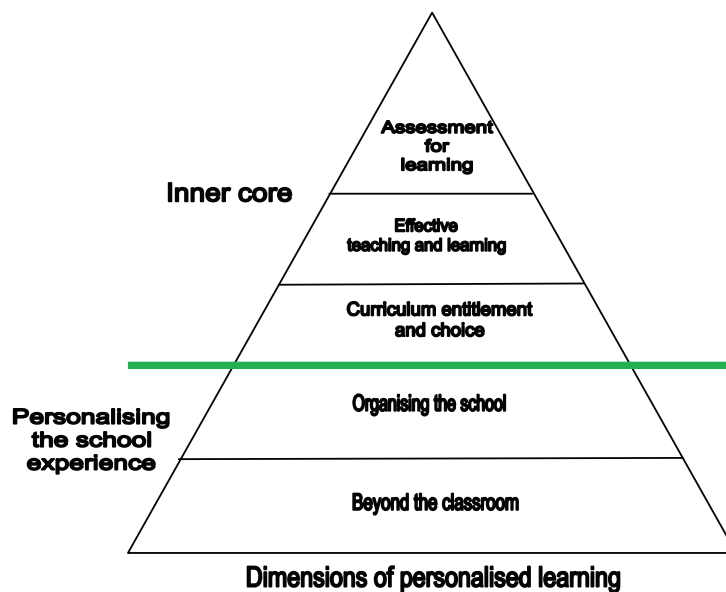
Figure 1.2 shows the growing diversity and therefore the constantly changing environment within the classroom, together with the changing demographics of the classroom. In South Africa, teachers are also having to cope with a changing educational system and renewed curricula. These problems however, cannot become problems for the learners who have real educational needs. Figure 1.2 encompasses the frustrations and challenges which have become a very real part of today's teaching. Learners of today have surmounting outside pressures and are stimulated by exciting technology related gimmicks to which they have become accustomed and accomplished, making it even more difficult for the teacher to attract their attention.

The pressures prevailing in the classroom includes the teacher having to remain on the brink of the ever-changing education system, updating with latest trends, new methodologies and making use of technology in the classroom. Learners are faced with a host of opportunities at school going level and are challenged by external pressures to perform. There are vanishing opportunities, especially for high school drop-outs and learners who do not pass the basic requirements for school leaving certificates. The opportunities rapidly disappear. The pressures are multiplied by the apartheid of ignorance where those who are well educated can access and participate in the present

day economic system. For those who lack education, the door to opportunity is slammed shut, locking too many out of any real likelihood of economic opportunity and success.

Today's environment made one realise the secret to effective teaching. What the teacher does in the classroom matters, but what really counts, is what students are interested in and what they are willing to do. It is therefore paramount for teachers to switch their educational approach to a learner-centred approach. It is essential to get the learners involved and engaged. Each learner needs to be focussed on the task at hand. Educators therefore need to argue for forms of pedagogy that close the gap on everyday life (Trifonas, 2008: 211).

1.1.2 Dimensions of Personalised Learning



(Adapted from Barr and Parrett, 2008: 33)

FIGURE 1.3: DIMENSIONS OF PERSONALISED LEARNING

The ideal situation would be to personalise the school experience for each learner. This personalised education would allow for every learner to focus fully and therefore concentrate optimally. The idea is however a difficult task in small classrooms, let alone

in overcrowded classrooms that lack basic resources. As can be seen in figure 1.3, not only would personalised learning require a classroom management shift where the school and classroom would be reorganised to accommodate the learners, but it would also require an individual inner core construction where assessment and the curriculum would be organised for effective teaching and learning. The results would be that each learner would be afforded the opportunity to concentrate optimally in every lesson, focussing their attention on the lesson at hand. This possibility is real when technology is at the forefront. Higher levels of learning goals can be accomplished if supported by various technological applications (O'Donnell, Hmelo-Silver & Erkens, 2006: 3).

A close link exists between the terms concentration, attention and focus. They are often used synonymously and yet subtle differences do exist. Before analysing these terms within the classroom, it is necessary to take a deeper look at the meanings of the concepts: attention, concentration and focus as utilised through technology within this research.

1.2 DEFINITIONS OF CONCEPTS

1.2.1 Definition of Attention

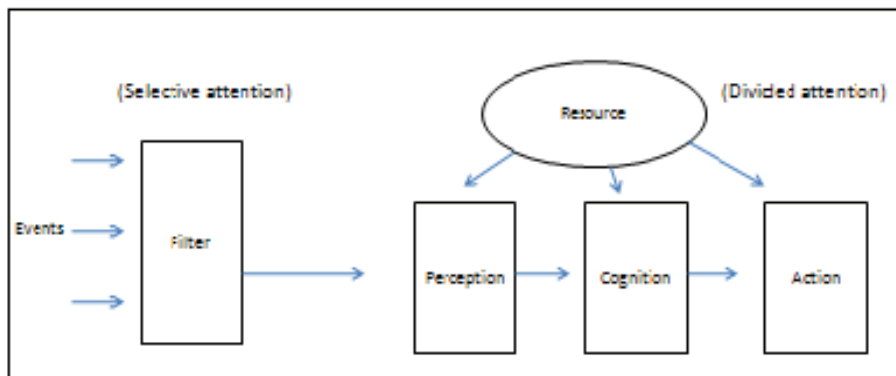
The oldest definition of attention can be traced back to William James (1890) as cited in Styles (2006: 1) who suggested that everyone knows what attention is. If, however, this was completely true, there would not be so many varied forms and definitions for the word 'attention'. James goes on to say that attention is the taking of possession of the mind in clear and vivid form... attention implies withdrawal from some things in order to deal effectively with others (Perry, 1935: 18). This explanation still serves today to encompass an effective definition of the word, attention. James as cited by Friedenber

and Silverman (2006: 75) suggested that substantive thought occurs when the mind slows down, perhaps when focussing attention. Vigilance has therefore often been thought of as the essence of attention, according to Neisser (1976: 27).

A widely accepted more modern interpretation of attention can be seen in Hale and Lewis' (1979: 31) description when they state that "attending" refers to perceiving in relation to a task or goal, internally or externally motivated. Attention, then, relates perception to action and to a person's needs and motives. Good attention therefore refers to perception that meshes with performance by efficiently picking up the information that has utility for a particular task. We speak of attention when the task and the expectancy of impending information are relatively specific (Hale & Lewis, 1979: 7).

Attention is divided into more specific elements (Kramer, Wiegman & Kirlik, 2007: 239):

- selective attention – a selected aspect of the external world
- focussed attention – breaks down when processing selected elements
- divided attention – efforts to process multiple channels of information
- sustained attention – the mobilisation of concentrated effort for some time



Adapted from Kramer, Wiegmann & Kirlik, 2006: 240

FIGURE 1.4: ATTENTION DIVERSIFICATION

Attention not only acts as a filtering system to decipher what object should gain one's attention, but as can be seen in figure 1.4, attention also supports perception, cognition and action. In this way, one can focus attention on tasks and mental operations.

Attention is also defined as a system of cognitive control in which the vast amount of information processed by the cognitive system is reduced to a tolerable extent (Ackerman, Kyllonen & Roberts, 1999: 162). Linking this definition to figure 1.4, it is obvious that focussing one's attention, is well within one's own control and not ad hoc as we would like to think. In other words we can pay attention to something if we are motivated, or have the need to do so.

Any reader who turns to a book with the word 'attention' in the title might be forgiven for thinking that the author would have a clear idea or precise definition of what 'attention' actually is. Unfortunately, attention remains a concept that psychologists find difficult to define (Styles, 2006: 1). The problem is that attention is not a single concept, but the name for a variety of psychological phenomena, according to Styles (2006: 5).

1.2.2 Attention Operationalised

Attention is seen as the cognitive process of selectively concentrating on one aspect of the environment while ignoring everything else happening around. Attention refers to the process used to select an element of available information upon which to focus for enhanced processing and integration.

Attention, according to Broadbent (1958: 19), can be subdivided into three aspects which are consequential and yet almost simultaneous. This includes orientating oneself to the topic, filtering this incoming information and then searching, either for the new information or for a familiar platform on which to base one's existing information.

Attention can therefore be focused upon a single information source or divided among several sources.

Focal attention is when attention is orientated towards a particular locus in space. This is also known as *spatial* attention. However, if attention is orientated on an object by means of the use of one or other sensory organs, including visual, auditory, smell or taste, it is called *object-oriented* attention. Focussed attention can be controlled in a goal-driven or a stimulus-driven manner for both spatial and object-oriented attentions.

Attention therefore can be voluntary or involuntary and it can include the use of the senses commonly known as exteroceptive, or it could be interoceptive and therefore independent of external senses (Kramer et al. 2007: 16). Where to allocate attention remains within the power of the individual.

In the classroom setting, having the learners' attention would imply that the lesson being taught or the stimulus presented is of such an interest to the learners that they have no need or desire to wander from the topic under discussion.

1.2.3 Definition of Concentration

Concentration can be defined as that faculty of the intellect which focuses single mindedly on one object without interruption. It must be emphasized that true concentration is a wholesome one-pointedness of mind. Concentration has been defined as "the ability to direct one's thinking in whatever direction one would intend". (Gunaratana, 1994). The art or practice of concentration is to focus on the task at hand and eliminate distraction (Mann, 2005). If the two definitions above were to be combined and tweaked specifically for school purposes, we could probably conclude that

concentration is the skill needed by a learner to focus on the lesson for a period of time without allowing one's thoughts to be distracted.

Concentration can be summarised as complete attention using intense mental effort. Concentration is often used synonymously with selective attention (Graf & Schachter, 1985: 511). Concentration assists one to confine one's thoughts to relevant stimuli in the presence of irrelevant stimuli.

1.2.4 Concentration Operationalised

In order to concentrate, a specific skill needs to be acquired. As with any skill this means practice, repeated day after day, until the skill can be utilised as and when required. The more one practices the power of concentration, like any skill, it becomes easier. This is particularly noticeable as one matures and one's concentration span increases. Initially when one begins school, his/her concentration span is limited but over time this improves (Pickering, 2006: 20). As stated in the above definition, concentration occurs on a topic of choice, directing one's attention where needed and maintaining concentration on the chosen topic. However, in a classroom setting, the learners' concentration might not coincide with the teacher's intended target.

The ability to concentrate depends on a number of factors according to Friedenber and Silverman (2006: 75) including:

- commitment
- enthusiasm for the task
- skill at doing the task
- emotional state

- physical state
- psychological state
- the environment

The learner needs to be actively involved in the concentration process by consciously focussing his/her attention on the stimulus and the material being taught and then attempting to linking this new material with pre-knowledge in order for learning to take place and for the new material to be acquired and remembered.

1.2.5 Definition of Focus

The centre of interest of an activity is often known as the focus of interest. The most apt definition of focus was taken from Erikson (1976: 121) who described focus as the goal-directed orientation of the spotlight. Focus is particularly important if many things are happening at any one time and therefore competing for the learner's attention. It would therefore be necessary to direct one's focus towards a particular point or purpose. If a learner is not aware of the focus, he/she will not know where to direct his/her attention.

One often presumes that everyone knows where to look or what to focus on. This sometimes needs to be pointed out and made apparent in order for all learners to focus on the correct stimulus or material. It is then up to the teacher to ensure that the learners' focus on the intended material, by making use of novel methods and unique teaching stimuli which are of interest and relevant to the learners, in order to make the required learning material appear attractive.

1.2.6 Focus Operationalised

A focal point is the actual position in which we require concentration effort. It would seem as if the more one can direct this focus of attention on a required target, the better one is able to concentrate. Selective attention would allow the learner to opt for the relevant focal point.

One's focus of attention can be likened to the package or wrapping around a gift, intriguing the receiver to such an extent that they cannot wait to rip the covering off to reveal the box, which in this analogy could be seen as attention. Once the box has been opened, one gets down to the instruction manual and the actual present, which could be seen as the concentration.

To summarise: The link therefore, from the above definitions seems to be that concentration is the focus of attention. Attention is regarded as automatic and effortless whereas concentration is voluntary and effortful (Rapaport, 1945: 168).

1.3 TECHNOLOGY AND TEENAGERS

Literacy in the 21st century requires that one is a critical thinker and creative producer of an increasingly wide range of messages using image, text and sound along with the ability to locate, access, analyse, evaluate, manipulate and communicate information effectively in a variety of formats including printed text, graphics, animation, audio, video and motion (Niess et al. 2008: 75). Thus literacy in the 21st century requires a high usage and understanding of technology. Chiapetta and Koballa (2002: 26) describe technology as tools invented by humankind to make work easier and life better.

To be truly youth participatory, an activity must involve the teens in all areas of the work, from determining what needs to be done to deciding the best way to complete a given task and carrying it through to completion (Braun, 2003: 11).

Schools therefore need to ensure that the learner is actively involved in the learning material, in order for the learner to take an active interest in the school system and for each learner to become more responsible for their own learning environment. Technology is the preferred method of communication (Braun, 2003: 26) for teens of today. Teens enjoy technology and are captivated by its appeal.

The fact therefore that learners spend hours glued to some form of technology and yet seem to battle to pay attention for a few minutes in a classroom shows that Pascopella (Bitter & Legacy, 2008: 103) does not exaggerate when he described a school of the future would be one that makes use of gaming software, text recognition, wireless connectivity, speech recognition, advanced hand-held devices, accessibility and virtual reality if wanting to remain applicable to today's education.

1.4 PROBLEM ANALYSIS AND FORMULATION

1.4.1 Demarcating the problem

Teachers are finding their days significantly devoted to discipline. A sizeable amount of a teacher's time is spent on trying to focus the learners, bringing them mentally and sometimes physically back to the learning environment. Learning is significantly affected if the learners fail to engage. Although teachers prepare wonderful lessons, often little is learnt in the classroom as the learner's life-world is far removed from the current situation in which he/she finds himself/herself in the school environment.

Today's world is filled with technology and has marketing ploys aimed at attracting teenagers. Many South African classrooms are, however, equipped purely with a teacher who is expected to fulfil the needs of these same learners for the majority of the day. The teacher is expected to perform the exciting role of the techno gimmicks which are visually attractive and auditory stimulating. Education needs to help produce a variety of types of literacy to make current pedagogy relevant to the demands of the contemporary era (Trifonas, 2008: 45). Education and learning would become more exciting for the learners and would also help capture their attention and improve their concentration if the teachers use tools that are relevant to the life-world of the learner. Tailoring a program to individual learner's needs is what makes a multimedia program an educational success. Such success in the form of learner's motivation is also caused by better understanding of and engagement with relevant material (Lytras, Gasevic, Ordonez de Pablos & Huang, 2008: 189).

Many teachers have become very creative in the methods used and the stimuli they have invented in order to confine the attention of the learners. However, like a good shepherd, the teacher, from time to time in the lesson, may need to gently, but firmly, call back his/her straying flock (O'Flynn, Kennedy & MacGrath, 2003: 158). The learner's attention does not seem to remain on the subject at hand. It is therefore clear that technology will need to become increasingly present in the schools of the future. Teachers will need to be able to plan classroom activities that seamlessly integrate rich multimedia experiences which will interactively engage students in meaningful learning.

Many learners have some form of technology permanently wired to them at any given moment, except when at school. They seem to manage to perform auditory and visual

tasks simultaneously out of the classroom. Do learners however manage to concentrate on the school lessons during the day? Have we adapted in our classrooms to accommodate the techno-world that we are constantly engaged in? A famous quote from John Dewey states that “if we teach today as we taught yesterday, then we rob our children of tomorrow”! (Niess et al. 2008: 1)

In 2003, Learning for the 21st Century (www.21stcenturyskills.org) report outlined six key elements of 21st century learning:

- Emphasise core subjects
- Emphasise learning skills
- Use 21st century tools to develop learning skills
- Teach and learn in a 21st century context
- Teach and learn 21st century content
- Use 21st century assessments that measure 21st century skills

The context, therefore, in which technology is used and how it is used are crucial factors in how well it may support learners (Anderson-Inman & Horney, 1998; Kern, 2006: 201).

No technology is able to replace the teacher in the classroom. It can however be successfully integrated into lessons which could maximise the learning experience while speaking in the language of today’s learners. Technology could help the teacher meet the learner on common ground, which would help capture the learner’s attention. Technologies reshape knowledge, literacy and pedagogy in the school classroom (Jewitt, 2006: 161).

1.4.2 Problem Scrutiny

The learner's attention is focused, when he/she has learned what to look for and what to ignore in the learning environment. Significant patterns then become clear to him/her. He/she then realises what is important and ignores extraneous and irrelevant material. Until such time, however, he/she constantly fights the battle of allowing his/her concentration to drift. It seems that there are more continual battles and fewer victories in this regard nowadays in the classroom.

Teachers know and recognise the tell-tale signs that show whether a learner is attending to the intended situation in the classroom. The tell-tale signs are still recognisable today but the learners who are concentrating seem to be becoming fewer. A teacher's experience definitely helps in identifying and recognising learners who are paying attention. If a learner is not alert to the learning environment, he/she will not profit from the teaching. Ashley (2005: 10) points out that it is not the fact that children cannot pay attention, but that today's children have great difficulty sustaining attention in tasks that require mental effort. Learners are therefore finding difficulty in reaching a point of concentration.

The researcher's 20 years of teaching experience in South Africa includes many noteworthy improvements and changes within the education environment. One important facet, however, which seems to have degenerated throughout the years, is the ability of children to pay attention in class during lessons for any considerable period. Sigman (2007:19) recognizes that we are living in an 'attention deficit culture'. When discussing this same view with teaching colleagues it would seem that South African teachers are finding children more difficult to educate as it is apparent that they

do not manage to concentrate for any significant length of time. This captured my attention for further research and investigation.

Classrooms are filled with children who spend hours attending class but paying little attention to lessons, finding these lessons and teachers far removed from their life-world. It seems as if “many students find it difficult to stay on task for any length of time” (O’Flynn et al. 2003: 76). “Pay attention!” serves to arouse the learners for a short while however, for consistent, long-term enhancement of concentration the teacher must identify precise problems and try specific remedies which may be suggested within further research, once this analysis of concentration, focus and attention has been carried out.

One cannot command someone else to concentrate. It is not an action verb that can be taught or instantly acquired. It is the synchronisation of one’s alertness, selectivity and central processing as a mental activity which initiates the interest of the learners in the classroom (Posner, 1975: 2). According to Pribram and McGuiness (1975: 131), from a physiological point of view, it is the interacting of arousal, activation and effort.

We can parallel the processes - arousal/alertness; activation/selectivity; and effort/central processing. Arousal and alertness is the reaction and sensitivity to the stimulus. Activation is the coordination of arousal which in essence is selective attention. Effort is the amount of attention required to maintain active processing of information and therefore activation of interest. These steps can be likened to the planting of a seed, which needs the correct amount of water, light and nutrients in order for germination to take place and the true fruits to emerge. At one or more of these

stages it would seem that either the input by the teacher is not arousing or alerting the learners, or the activation is not correctly being processed.

Children are often unmotivated to pay attention in class, finding the lessons mundane in comparison to the level of stimulation to which they have become accustomed in their exciting, constantly changing and instantly gratifying techno-world. In the era of instant gratification, students are accustomed to being “plugged in 24/7” (Bitter & Legacy, 2008: 77). In the classroom environment it is unlikely and virtually impossible for all learners to receive this instant gratification and instant feedback to which they have become accustomed. They therefore fail to sustain attention over a period of time which would result in them switching to a mode of concentration. Without this concentration, the lesson and effort on the teacher’s part becomes fruitless.

Students have grown up with television programs that utilize only short segments rather than 30-minute programs (Smaldino et al. 2008: 310). This trains them to concentrate for short spurts of time before the programme changes and they are then stimulated again by something new. In a classroom situation this would mean that the teacher would need to stimulate the lesson throughout the period and not just capture the attention of the learner during the introductory phase.

Research conducted in South Africa by Affleck (2007) as cited by Sigman (2007: 176), shows that the youth of today have become fragmented in the sense that their attention is drawn by myriad demands on their sensory systems. Is the excessive access to technology and the amount of time which learners of today spend on these devices and to which they have become accustomed, contributing to these learners not being able to

pay attention in the classrooms and therefore to them not advantageously concentrating in the schools?

Concentration also however depends on task difficulty. The cliché about doing something “in your sleep” means that the person is so skilled in performing that particular task he/she does not need to be wide-eyed and alert during its execution. Even the most intriguing task becomes boring if it is repeated without change. If one looks at the typical classroom atmosphere and learning climate, one is struck by the repetitive environment and dull attention grabbing tricks which are reeled out in order to seize attention and capitalize on concentration. Many classrooms of today have not changed much from the make-up and basic classroom of the past few generations. One only has to stop and think of significant changes that have taken place in one’s lifetime to know that changes also need to take place and keep up in the typical school and classroom in order for concentration to be maximised.

It is not the fact that new material is being presented but rather the method of presentation. Ainley and Luntley (2007: 16) refers to attention-dependent knowledge of teachers that seems to be failing even the most experienced of teachers. Teachers are generally sensitive to whether children pay attention and are even resorting to the use of doorbells, whistles and drums in order to attract the attention of learners.

The life-world of today’s learner is surrounded by constant stimulation, noise, movement and novelty. The teacher need not create a carnival atmosphere, but a certain level of activity and vitality is needed to maintain the learner’s level of alertness (Hale & Lewis, 1979: 303). Bright colours, sharp contrasts and unexpected novelty easily attracts attention, but it can also distract and may take attention away from matters of relevance.

It does not take long for a learner to be distracted and to focus aimlessly on an irrelevant stimulus instead of determining the meaningful material. Material will only seem relevant if it is of interest to the learner and therefore part of his/her life-world.

Research conducted by Razani, Burciaga, Madore and Wong (2007: 337) suggests that after an initial period of 10 minutes where children perform a vigilance task at optimal levels, the brain begins to shift from controlled to automatic attentional processing of stimuli. The implication of this study is that the teacher has precious little time to actively engage a student before they shift into “automatic pilot”, and no longer attend to the class lesson very closely.

South African classrooms are filled with children who come from a variety of backgrounds and who are challenged by diverse factors including language, cultural and racial differences; a multitude of economic standards; social and religious assortment just to mention a few. These children are expected to sit and pay attention for close on six hours every day. Many of us may comment that we all managed to achieve this feat – however, we were brought up in the pre-digital era, without twenty-four hour television and many other techno-gadgets, before the world of instant gratification and invariably we were taught in schools which had many learners from similar language, culture and backgrounds to ourselves.

Factors thought to affect concentration include nutrition, exercise and muscle tone, sleep pattern, language, motivation to learn and stimulation by the teacher, to mention a few. When dealing with children who spend many hours in front of a television or computer monitor and who are used to stimulation with a high level of interaction, is it

any wonder when information is not presented in a way that sparks attention, the information is discarded and attention withdrawn (Willis, 2005: 32)?

1.4.3 Problem statement

1.4.3.1 Problem

From the discussion so far, the following problem statement can be formulated:

“Is the lack of technology in the classroom a contributing factor to the problem of attention and concentration in the classrooms of today?”

1.4.3.2 Why is this a problem?

The purpose of school according to the Oxford dictionary is an institution which specialises in providing a systematic method of teaching in order for the young to be educated.

Today’s learners live in a world filled with stimulation. Many learners are therefore extremely efficient in the technological sphere, often assisting parents and teachers in this regard. Most classrooms, however, do not have the latest that technology has to offer and the teacher is left to improvise with whatever equipment he/she has at his/her disposal. This is often merely a chalkboard. If the learner’s life world is so far removed from the school world, he/she often finds himself/herself disinterested in the learning and unable or unwilling to concentrate. Inconsistencies and contradictions in his/her world take place, hampering the learning process which is of course the ultimate purpose of being at school.

1.4.3.3 Facets involved in the problem

The players who directly play a role in the teaching environment are clearly the teachers and the learners. However, indirectly, there are many other components involved in the learning environment. The parents, the home environment, the classroom atmosphere, the state of mind of the individual learners, the stimulation and the interest and motivation of the learners all play a role in ensuring that learning takes place or in some cases the hampering of the learning process.

1.4.3.4 What has previously been done to address the problem?

A great deal of time has been utilised to research attention and the lack thereof addressing ADD/ADHD in the classroom. However, little research has been carried out addressing learners in the classrooms of today who are not classified as ADD/ADHD. I do not intend to replicate previous research by taking the ADD/ADHD child into account. This research is intended to take a look at concentration and attention and to analyse this concentration and attention within today's classrooms.

1.5 JUSTIFICATION OF THE RESEARCH DILEMMA

From this preliminary discussion it is evident that there is a need to research the effect of technology on concentration and attention in the classrooms of today. Concentration studies conducted by Wubbels and Levy (1993:57); Wubbels and Brekelmans (1997: 84); Riah and Fraser (1998:1); Chionh and Fraser (1998: 2); Margianti, Fraser and Allridge (2001: 3); and Waxman and Padron (2002: 5) show that a general concentration problem in the classroom is not unique to South Africa. It would seem that this generation of learners world-wide have similar behavioural patterns and therefore similar concentration and attention spans. This apparent attention and concentration problem in the classroom therefore warrants further research and an in-depth analysis.

As mentioned, significant research has been carried out on attention and children who have ADD/ ADHD but this researcher could not find significant research which analysed the concentration and attention of the “normal” children in today’s South African classrooms. The following is therefore worthy of a thorough investigation:

“The effect of technology on the concepts attention and concentration within the classroom context”.

1.6 IMPORTANCE OF THE RESEARCH PROBLEM

This study intends to analyse concentration and attention within the classroom. While many teachers present brilliant lessons, there are still many learners who are finding school a waste of time and who show very little interest during lessons. An in-depth look at concentration as well as attention in the classroom should give an indication of whether a problem does exist in our classrooms indicating possible problem areas, as well as possible rectification methods that could be looked into in order to maximise attention and concentration within the classroom. This has an impact on teaching as we know it, in South Africa in the 21st century. This study could manifest within the following:

- The clarification of concentration within the classroom.
- The clarification of attention within the classroom.
- Identifying whether there is a lack of attention in the classroom.
- Identifying whether there is a lack of concentration in the classroom.

- Possible problem areas causing a lack of concentration in the classroom.
- Possible problem areas causing a lack of attention in the classroom.
- This could lead to a realisation that something needs to be done about the present way in which material is presented in the classroom.
- This investigation could provide possible rectifications for the present situation of attention and concentration in the classroom.

1.7 OBJECTIVES OF THE RESEARCH

1.7.1 Purpose of the Research

The primary purpose of this research is to analyse the effects of technology on the concepts concentration and attention within the South African classroom context. It is only once a thorough analysis of the concepts have been undertaken that further steps and research can be investigated within the classrooms concerning how to maximise the concentration and attention of learners in order to enhance the learning programmes.

1.7.2 Specific Research Objectives

The following specific research objectives have been identified in order to answer the primary problem. A literature as well as empirical investigation will be executed:

- The analysis of the concentration of learners in the classroom.
- The analysis of attention of learners in the classroom.

- The determination of the theoretical understanding of concentration and attention.
- The verification of the extent to which learners of today concentrate in the classroom during lessons.
- The verification of the extent to which learners of today have their attention captured and focussed on a specific interest target.
- A possible link between motivation and concentration.
- A relationship between motivation and achievement.
- A link between motivation and attention.
- The relationship which may exist between concentration and achievement.
- A possible link between concentration and attention.
- The development of a measuring instrument to determine concentration, motivation and attention within the classroom.

1.8 RESEARCH PROGRAMME

CHAPTER 1: Orientation, Problem Analysis and the Research Programme

Chapter one begins with a basic orientation of the research problem. It gives a basic analysis of attention and concentration in the classroom. Definitions of attention, concentration and focus are outlined and then discussed operationally. The research objective is demarcated.

CHAPTER 2: A Theoretical Analysis of the Concepts Attention, Concentration and Technology

The theoretical analysis begins with a timeline of the history of attention theories. It contains relevant concentration and attention theories which have been analysed according to the stimulus, enthusiasm and relevancy of the task; mastering the skill of concentration; memory and automatic attention; capacity for attention and the selection of attention. Because concentration, within this study is dependent on attention, a great deal of the theory is devoted to attention.

CHAPTER 3: Anchoring Attention and Concentration through Technology in the Classroom

Chapter 3 is devoted to anchoring the concepts of attention and concentration, thus giving a firm base as the stepping stone from which to conduct this study. This chapter contains the literature review associated with the topics of concentration and attention within the classroom giving a critical, factual overview showing where this study fits into existing research.

CHAPTER 4: The Method of the Empirical Investigation

The empirical research will be discussed, emphasising the detailed method in which the study is to be conducted, depicting all the elements which are to be achieved by the research. The research hypotheses will be outlined together with the research design, outlining the sample and measuring instrument. The procedures to be followed during the empirical investigation will be looked at, explaining the self-completion questionnaire

as well as the lessons taught in three learning areas and the tests administered thereafter.

CHAPTER 5: Results of the Empirical Investigation

This chapter will focus on the inferential statistics used to interpret the investigation. The norms of the measuring instrument will be determined. The items of the questionnaire will be analysed and the reliability coefficients for the two constructs, motivation and concentration, will be determined. The null hypotheses will be stated and tested together with an explanation of the calculations used during the testing process.

CHAPTER 6: Summary, Conclusions and Recommendations

In the Summary, Conclusions and Recommendations chapter, an overall view of the studies will be looked at and recommendations will be made based on the results of the empirical investigation. Possible implications for education will be outlined and discussed, limitations to the study will be acknowledged and certain conclusions will be reached concerning this research.

2. A THEORETICAL ANALYSIS OF THE CONCEPTS ATTENTION, CONCENTRATION AND TECHNOLOGY

A man who reviews the old so as to find out the new is qualified to teach others.

Confucius

2.1 INTRODUCTION

While researching the literature on attention and concentration, it became evident that, little theory exists on concentration as a concept. Attention however has been defined, vastly discussed and written about. It is therefore necessary to briefly outline the early ideas of attention before discussing the concepts of attention and concentration.

2.1.1 A brief historical background of attention

Models of attention have a respected history going back to Aristotle, who considered attention as a narrowing of the senses. The initial importance to attention arose from the relationship between attention and consciousness. Malebranche (Jowell, 1960: 6), a follower of Descartes, first suggested this relationship in the eighteenth century with Titchener (Jowell, 1960: 6) later describing attention as being identical to sensory clearness. Similar views were held by Wundt, Wolf and Pillsbury in the early 1900s (Jowell, 1960: 7).

Attention was later assigned the role of selectivity, resulting in research by Binet (1916) and Paschal (1941), who both emphasised the importance of Holt (1915) (Kemp, 1969: 141). Holt spent a great deal of time analysing many of the factors relating to attention.

Dashiell (1928) agreed with Pillsbury (1908) who found that attention was a response to a stimulus (Jowell, 1960: 7). Therefore two distinct interpretations of attention developed with the radical thought being on the mental set platform, while the more conservative thinking remained with selectivity.

A whole new approach to attention developed with Thorndike (1905), introducing the “mental set” (Jowell, 1960: 11). This he termed for the intention of performing a problem. Dashiell (1928) (Kemp, 1969: 142) attempted to clarify the relationship between attention and the mental set. This later gave way to the term “preparatory set” or “adjustment” until Woodworth (1940) (Jowell, 1960: 13) brought “mental set”, “selectivity” and “attention” together. This implies that attention is an active, purposeful and anticipatory process.

Throughout the history of psychology, attention has played a role in theories of cognition. A timeline of attention theories can be seen in Appendix A.

2.2 AN INDEPTH LOOK AT ATTENTION AND CONCENTRATION THEORIES

A number of theories of attention have made a significant impact on the way we view both attention and concentration. These theories do not always concur.

Schneider (1994: 180) considers what functions we might attribute to attention. He identified three broad classes of attention theories:

- i. selection-for-object-recognition (for example Marr)
- ii. selection-for-feature-integration (for example Treisman)

- iii. selection-for-action (for example Allport)

These attention theories along with others have been selected for in-depth analysis purposes. They have been grouped and analysed according to their common features under the following headings:

- stimuli to attract attention
- the will to attend - motivation
- mastering the skill of automatic attention, concentration and memory
- an individual's capacity for attention
- the selection of attention

2.2.1 Stimuli to attract attention

Allport (Styles, 2006: 3) suggests a practical model of attention that combines bottom-up analysis with top-down controls, at different levels of sensor and actuator signal processing. The selection and fixation of attention is thought to result from the optimization of an objective function that includes both data-related and knowledge or task-related quantities. Gagne (1968: 179) supports Allport's suggestion that gaining the attention of the student is the first step in successful instruction (Styles, 2006: 5). Some form of stimulus or "interest device" needs to be used to grab the learner's attention.

The Stimulus-Response theory was however first proposed by Treisman (1969: 30) and then Kahneman (1973: 114) where two distinct functions are controlled by different aspects of the information presented...: *stimulus* choice, the segregation of relevant

items from irrelevant ones, must be guided by some identifying property...; *response* choice is controlled by other properties.

Glasser (O'Flynn et al. 2003: 108) however rejects this basic Stimulus-Response theory. He suggests that people and especially learners will only concentrate if the topic being discussed has a direct impact on one of the following four factors which Glasser believes to be the basis behind all that holds our attention. Glasser (O'Flynn et al. 2003: 108) suggests that apart from the basic survival needs of air, water, food and shelter as in Maslow's hierarchy, there are four other needs that all humans strive to satisfy, whenever they do anything. These needs are to have 'fun', to experience 'freedom', to have a sense of 'power or status' in their lives and to feel 'loved or a sense of belonging'.

These ideas on attention, though contradictory, give rise to the idea that a stimulus, related to the fulfillment of one of Glasser's suggested basic needs, will capture the attention of the learner and sustain this attention until the need is fully met. Being inattentive implies attending to too many stimuli or attending to the wrong stimuli.

Broadbent's (1958: 210) "filter theory" is based on a filtering process which he believed to be the selection of a stimulus feature on the basis of possible interpretations. It thus allowed for the influence of long-term memory or for the meaning of a stimulus. Navon and Gopher (1979: 214 - 255) offered a similar theory, preferring to call the processes "Suggestion" and "Inquiry". They, as did Broadbent, believed that the first or primary stage of attention was the taking in of information. Shiffrin and Schneider (1977: 140) however define selective attention as "control of information processing so that a sensory input is perceived or remembered better in one situation than another". This

suggests that appropriate stimuli will uphold a learner's attention which will later be remembered due to the suitability of the stimulus. Kahneman (1973: 115) put forward a theory that likens attention to a limited resource that can be flexibly allocated as the human operator changes their allocation policy from moment to moment. Attention can be focused on one particular activity or can be divided between a number of activities. When tasks are more difficult, more attention is needed.

Posner's study (1975: 2) and Posner and Rothbart (2007: 56) indicates that children orientate their attentional resources automatically to abrupt visual onsets, and do so under conditions which are not necessarily beneficial to overall performance. The critical role of attention in visual stimuli was also found to be of the utmost importance to Ballard (1991), supported by the work described by Yarbus (1967), Neisser (1967), Richards and Kaufman (1969) as cited by Kramer et al. (2007: 43).

Van der Heijden, La Heij, Phaf, Buijs, and Van Vliet (1988: 259 -277) on the one hand offered a "connectionist model" as an explanation for attention. They believe that one mechanism is needed for object selection called mechanism object set. An example of this is the intriguing colours on a picture held by the teacher. Another mechanism is needed for attribute selection, called "mechanism attribute set". An example is the game which the children in the picture, held up by the teacher, are playing.

Bundesen, Pederson and Larson (van der Heijden, 2004: 82) on the other hand proposed the "biased-choice model" for single-stimulus recognition, with the fixed-capacity independent race model for selection from multi-element displays. Shibuya and Bundesen (1988: 598) went on to develop the race model which takes into account the duration of the stimulus which then spurred Bundesen (1990: 530 - 547) on even further

to develop the computational theory by integrating the race model with the biased-choice model for single-stimulus recognition. Wickens (Kramer et al. 2007: 43) introduced a theory commonly known as the multiple-resource model of dual-task performance. Unlike Phaf (1986) and Bundesen (1990), Wickens (1984) as cited in van der Heijden (2004: 82), postulated that more than one task can be undertaken when there are different input resources (visual and auditory) and for instance diverse output (manual and speech) modalities.

Parasuraman and Davies (1976: 580) agree with Wickens' multiple-resource model of attention (1984) as cited by Kramer et al. (2007: 43) and refer to the multidimensional construct, involving selection of information, sustained over time, more focus on certain stimuli relative to other stimuli and a switch between tasks. So it literally becomes the bigger and better visual stimulus that will win the attention of the learner, regardless of whether this is relevant to the classroom learning at the time. Lack of concentration would therefore mean the lack of the correct habits of concentrating; an inability to exclude irrelevant stimuli for sufficiently long periods of time.

The particular set of stimuli which is selected seems to be determined first of all by external conditions, i.e. aspects of the stimuli such as size, intensity and volume and secondly by drive and motivation. In Treisman and Souther's (1986: 14) attenuation model, the selective filter distinguishes between two messages on the basis of their physical characteristics, such as location, intensity and pitch. The learner could appear to be daydreaming, but he/she is actually paying full attention, just not to the material that the teacher had anticipated at the time. Something else must have appeared to be visually more stimulating and therefore attracted the learner's attention.

From the models supplied by van der Heijden et al. (1988: 265) and Bundesen (van der Heijden, 2004: 82) it would seem as if the choice of stimulus is the key. The stimulus which is currently more motivating to the learner will appear more attractive and gain the learner's attention. Neisser's (1976: 215-230) stimulus-properties theory is congruent to these findings as he proposed that both properties of the stimuli as well as the semantic factors play a role in attention.

Wickens (Kramer et al. 2007: 171), however, believed that multiple stimuli could elicit multiple tasks. It seems that the importance is not in the number of stimuli provided, but rather the correct stimuli. Kounin and Gump (1974: 560) and Lemlech (2004: 134) found that even quite dramatic stimuli in simple displays can pass by unnoticed if attention is directed elsewhere. Kounin called this inattention blindness (Mack & Rock, 1998: 70). Attention therefore was often viewed as a neural system for the selection of information, similar in many ways to the visual, auditory or motor systems according to Posner and Dehaene (1994: 77). Therefore as Hebb (1952) plainly states, (Sigman, 2007: 162), "man is continuously responding to some events in the environment and not to others that could also be responded to"; implying that attention is a response to an environmental stimulation. Applying this to a classroom situation, a learner could be attending to the wrong stimulus and would therefore appear to be inattentive.

The particular set of stimuli which is selected seems to be determined first of all by external conditions, such as size, intensity and volume and secondly by internal conditions i.e. drive and motivation. Stimuli which are persistent, irregular and strong will be attended to because they break up the existing pattern or cortical activity. The process of selection in attention and concentration is basically the same from the above theories, but concentration may be thought of as a much higher degree of attention in

that the selection of stimuli is more refined and the operation of the activity continues for a longer period.

Tomasello, Kruger and Ratner (1993: 520) have presented evidence to show that one's attentional skills begin to mature when one understands and sees others as intentional agents. In other words, when children view others with intention, they begin to understand that these people (in the school setting - a teacher) have selected attention and that they intend for the learner to selectively attend to some things in the environment and to ignore other things.

2.2.2 The will to attend (motivation)

Kahneman (Styles, 2006: 156) observed that if incoming messages have relevance to the learner according to existing knowledge, attention will be tuned in to a far greater extent than if it is irrelevant data which has no basis and no relevance for the learner at that particular time. This would indicate that a conscious choice is made by the learner on where to focus his/her attention. The learner is motivated to attend to something. Gagne (1968:180) and O'Flynn et al. (2003: 109) agree with this in their theories, stating that drawing the learner's attention to the fact that they are actually going to learn something and what it is that they will be learning, is the first step in attracting the learner's attention in the learning process. The learner becomes motivated if the learning situation appeals to them. Kounin (Lemlech, 2004: 133) in contrast found that a student's attention greatly improves when he/she is kept in suspense which could be achieved by randomly calling on students in order to keep them on their toes regardless of whether or not the lesson has great relevancy for them. This implies that if every student is alert and following the lesson, as they are not sure when they may be called upon, they will force themselves to concentrate to ensure that they are attentive when needed. This motivates the learner to stay focussed. This is possibly linked to the ego

which plays a huge role in a teenage classroom setting. An example can be seen when a teacher randomly calls on pupils to read in class, no learner wishes for the others to think that he/ she is unable to cope with the lesson and they all follow in the book, in case they are the next “victim”!

For children who struggle with or who have been turned off by more traditional school activities, electronic technologies may stimulate their interest in learning and motivate them to want to learn, by adding a fun factor, while at the same time giving them some control over what and how they learn and enabling them to demonstrate their learning in new ways (Parker, 2008: 281).

Deutsch and Deutsch's attention model (1964: 7) suggests that selection is determined by the significance of the sensory input to the learner. They propose that unless the information holds personal relevance for the individual, the recognition and selection are recognised but are quickly forgotten. Norman (Fisher & Khine, 2006: 205) supplemented Deutsch and Deutsch's (1963) model (Kramer et al. 2007: 43) adding a 'strength' dimension, suggesting that although relevancy and commitment are important in attracting attention to a task, the strength of the input is vital in maintaining the concentration.

Marr (Styles, 1997: 118) in his Bayesian theory claims that the learner will focus on the target that attracts his/her attention the most. He refers to this as visual pop-out, where the target of attention is sufficiently different from other distracters. In other words, it literally pops out from the visual resources that the learner is focussed on. In contrast, Shiffrin and Schneider (1977: 150-180) offer a theory pertaining rather to subsets of information as one's capacity for information is overloaded by too many distracters, one

quickly subdivides this information into subsets and simultaneously chooses the most relevant subset on which to focus attention. Therefore according to their theory, cognitive load will affect the rate of acquisition.

Rather than relevancy of a task, Eysenck (1981: 348) and Goh and Khine (2002: 3) based a concentration theory primarily on physiology and genetics focussing more on temperament of the individual. They believe that some people have a more responsive sympathetic nervous system than others which enables them to remain calm and therefore allows them to concentrate on the task at hand. Other people however in a similar situation are anxious and therefore allow their emotions to interfere with their ability to concentrate. This affects an individual's ability to concentrate on tasks particularly in stressful conditions which in a school setting is invariably during test and exam periods, which is the assessment culminating in concentration. According to Eysenck's temperament theory of concentration, the ability to concentrate could therefore also be affected if a particularly strict teacher who has an effect on certain learners by making them feel awkward, apprehensive or even nervous is in the classroom. The sympathetic nervous system would, in certain individuals, be negatively affected impeding the individual's concentration and therefore his/her performance.

2.2.3 Mastering the skill of automatic attention, concentration and memory

Kahneman (Styles, 2006: 156), and La Berge and Samuels (Kramer et al. 2007: 157) suggested that attention is a skill that can be improved upon. Kahneman (Styles, 2006: 156) also suggested that attention can be consciously focussed upon. Practice in other words can play a role in lengthening the time that one can pay attention and therefore concentrate. This same idea is agreed upon by Shiffrin and Schneider (1977: 163) who suggested that automatic attention attraction comes about through practice which

culminates in consistent training. They do not however seem to make a distinction between automatic detection of featured information and automatic detection that requires training.

Kellman, Guttman and Wickens (2001: 206) concur with Kahneman (Styles, 2006: 156) that it is possible to train the mind to concentrate more astutely when needed, and that focussing 100% on the task at hand is a skill which over time can become more automatic. However, further research by Cheng (1985); Kahneman and Chajczyk (1983); Styles (1997); and McCann, Remington and Van Selst (2000) has cast doubt on the general notion of automaticity. Genuinely automatic cognitive processes which make no demands on central capacity have been very hard to find (Jimenez, 2002: 12). For instance, on the basis of the “Stroop effect”, word reading is often presumed to be an automatic response to a visual stimulus. Research conducted by Kahneman & Chajczyk (1983: 508) however showed evidence that Stroop interference is diluted by the presence of additional words within the display. Their conclusion therefore was that even word reading is not fully automatic.

Posner (1975: 2) and Styles (2006: 218) drew the distinction between automatic activation processes that are solely the result of past learning and processes that are under current conscious control. They believed that when a learner is in “automatic’ mode, processing is a passive outcome of stimulation which does not draw on attention capacity. There appears to be developmental change in this regard which would account for the fact that most learners who have been at school for a number of years appear to be able to concentrate for significantly longer periods of time in contrast to learners who are new to a school system and who are therefore usually much younger

and have not yet become accustomed to routine and who need far more ongoing stimuli in order to maintain interest.

Van der Heijden et al. (1988: 273) and van der Heijden (2004: 82) on the other hand designed a connectionist model which is in contrast to the idea of purely automatic processing that occurs without attention. This is in direct contrast to Shiffrin and Schneider (1977: 153) who went on to suggest that the automatic feature detection is an innate process. Automatic detection can therefore be summarized as operating independently of a subject's control and independent of attention. Treisman and Souther (1986: 13) agree that while simple search on features and trained automatic responding appear similar, they have different origins of independence from attention. They proposed a Feature Integration Theory which they divided into two stages. The first stage they termed the pre-attentive stage as it happens automatically, without effort or attention by the perceiver. They believe that this happens extremely early in the attention process so that one is not even aware of the stimulus when it is already broken down into elementary features such as colour, texture and shape. Logan (Spencer & Blades, 2006: 92) however makes a further distinction between these processes by arguing that automatic detection is a post-attentive process that is dependent on attention. These conflicting ideas and theories complicate the understanding of the attention process and confirm that we are only capable of measuring the output of attention but not the attention process itself.

Broadbent (1957: 211) based his stimuli selection on filtering, as was discussed previously. However, he believed that the filtered information could be stored in "pigeon-holes" of the long-term memory. To follow on from this, Broadbent (Kramer et al. 2007: 170) reasoned that the most appropriate interpretation received was given after the new

information had been compared with the information stored in one's "pigeon-holes of information" on a topic. Therefore attention would only be selectively given to information which could be linked to existing information or knowledge which was retrieved from the memory bank. One therefore automatically remembers a link to a previous topic and therefore devotes attention to the new information which builds on existing memory links and therefore builds one's automatic attention. This theory is backed up by Navon's and Gopher's (1979: 237) second stage of inquiry which included the probing of the environment in order to corroborate the newly acquired information with what one already knows.

Kounin (Lemlech, 2004: 133) focused his theory on a teacher's ability to affect student behavior through instructional management. He was fascinated with the ricochet effect that the teacher had on learners. Without even realising their reactions, a student would react to the environment and in this case the teacher, even when he/she was not actually referring to that particular learner. It became automatic for a student to model his attention on another student who received a positive reaction from the teacher. He observed this pattern in student behavior when he asked a student in his own classroom to put something away; he noticed that the students around him automatically followed in focusing their attention on the same task at hand.

Models by Deutsch and Deutsch (1964: 5-8) and Norman (Kramer et al. 2007: 43) also attempted to merge information regarding memory and the selection process of attention. These models suggest that a recognition stage is an important aspect of the theory, where attention is equivalent to the selection stage, where one selectively chooses which stimulus to focus on. Neisser (1976: 44) who argues in favour of a constructivist view agrees that attention is influenced by experience, as one knows from

past experience which is the more interesting alternative. Bundesen (1990: 540) proposed a theory based on visual recognition which adds value to attention of tasks. If something is recognised it must be from previous experience, thus Bundesen (1990: 553) agrees with Neisser's (1976: 213) constructivist theory of concentration.

2.2.4 An individual's capacity for attention

If one has a milk jug, its capacity will only hold a certain amount of milk, depending on the manufacturer's requirements. Similarly, one's capacity for attention can be limited, according to Shiffrin and Schneider (1977: 163). This often limits a learner in the classroom who wants to participate in class but finds himself/herself unable to pay attention due to an overloaded system – the learner has so much information which he/she is trying to digest that the system gets overloaded and instead he/she ends up not focussing at all. Too many stimuli at one time could be less motivating than no information, as the learner is unable to cope with what is happening in the classroom. Shiffrin and Schneider (1977: 170) and Kramer et al. (2007: 158) did however also postulate that many tasks which previously required attention, could later become automatic which would assume that less attention would later be required for the same task. Similarly Moray (1967) and Kahneman (1973) as cited in Kramer et al. (2007: 171) proposed that one's demand for attention is limited to its supply and that one's demand for attention is often limited by the potential of the individual's concentration capacity.

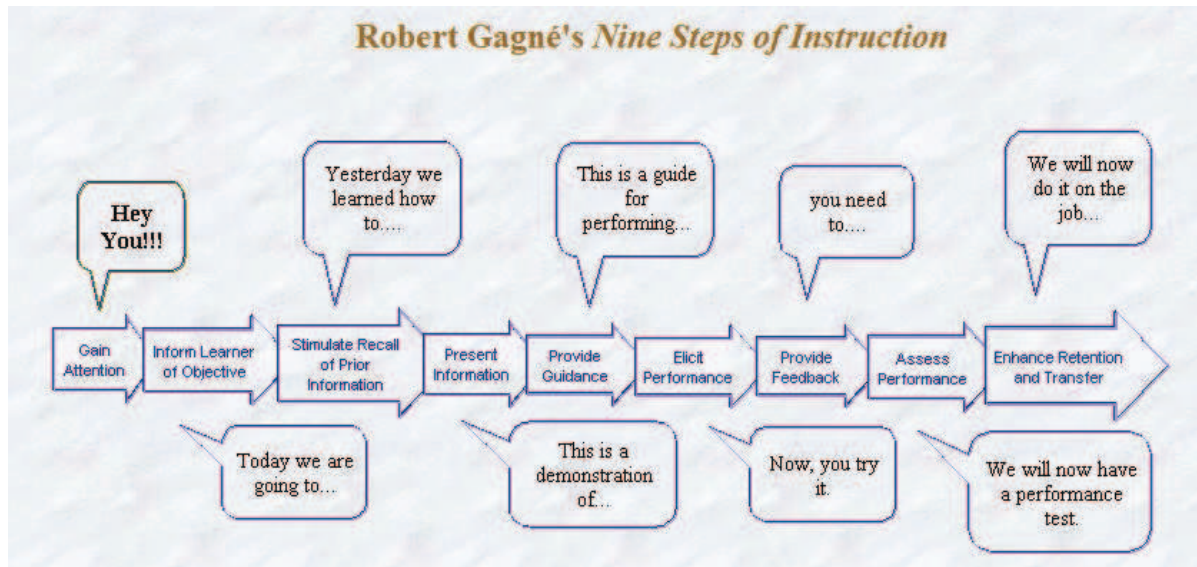
Looking back at the milk jug analogy: If the milk jug is turned upside down, the capacity of the jug to hold milk is not only limited but it is now severely hampered, although the shape and size of the container has remained intact. Similarly, learners' capacity to sustain attention is limited by the lesson. They might be able to sustain attention for a long period of time while engaged in another activity but cannot engage during a lesson that holds no or little value for them. Capacity therefore also means the capacity one

has to sustain attention over time. Parasuraman and Davies (1976: 583) suggested that the capacity to sustain attention deteriorates over time for certain tasks. This is especially true in discrimination and monitoring tasks.

The term a “vigilance decrement” results from a decrease in perceptual sensitivity if, firstly the target discrimination loads the memory and secondly if the stimulus events occur too rapidly. Selective attention is therefore thought to be the result of various levels of attention to visual and auditory modalities. This is reliant on one’s attention capacity which involves selecting information, sustained effort over time and a switch between tasks.

Posner (1984: 248) theorised over control considering the act of orienting attention toward the target in terms of three mental operations: disengaging from the current focus of attention, moving attention to the location of a target and engaging the target. These mental operations depend entirely on one’s capacity for attention as well as one’s capacity to sustain this attention which will have an effect on the quality of the learning which takes place.

Gagnè (1965: 180) suggested nine steps of instruction (figure 2.1), which assists in attracting attention and maintaining concentration in the classroom, in order to increase the capacity to sustain this attention by reinforcement and interest. Gagnè includes the learner in the instructional process in order to maintain concentration and does not believe that learning is purely reliant on teaching. He believes in the involvement of the learner who will automatically engage in the learning environment if he/she is drawn into the teaching thereof.



(Adapted from www.en.wikipedia.org/wiki/Concentration)

FIGURE 2.1: GAGNÉ'S LEARNING STEPS

TABLE 2.1

EXPLANATION OF GAGNÉ'S NINE LEARNING STEPS

A table to explain Gagné's Nine Learning Steps	
Instructional Event	Internal Mental Process
1. Gain attention	Stimuli activates receptors
2. Inform learners of objectives	Creates level of expectation for learning
3. Stimulate recall of prior learning	Retrieval and activation of short-term memory
4. Present the content	Selective perception of content
5. Provide "learning guidance"	Semantic encoding for storage in long-term memory
6. Elicit performance (practice)	Responds to questions to enhance encoding and verification
7. Provide feedback	Reinforcement and assessment of correct performance
8. Assess performance	Retrieval and reinforcement of content as final evaluation
9. Enhance retention and transfer to the job	Retrieval and generalization of learned skill to new situation

2.2.5 The selection of attention

When a learner focuses his/her attention (Kramer et al. 2007: 170), the selection of attention made will not only depend on the learner's previous set of information, but also on the learner's ability to select relevant information. In a classroom setting the lesson is generally already relevant to the previous lesson based on a specific topic. A simple reminder might assist the learner to recall what was previously taught in order for him/her to retrieve information, in order to link the newly acquired knowledge. This was postulated by Broadbent as far back as 1958. Treisman and Gelade (1980: 114) also believe that selection is made according to content. Treisman's (1980: 120) information processing and selection theory was based on Spelke's, Hirst's and Neisser's (1976: 221) theory concerning simultaneous operating selection and a selective filter based on Broadbent's theory, together with a set of 'central structures'. A learner's attention will therefore be directed according to the most interesting stimulus which he/ she can relate to at the time.

A stimulus is needed in order for learners to want to participate in a lesson and to select this lesson for their undivided attention. Controversial Hebb (1952), head of American Psychology in the 1950's and 60's stated that man is continuously responding to some events in the environment and not to others that could be responded to (selection of attention). Behaviour and learning therefore is a response to environmental stimulation. This stimulation is what attracts our attention, and the extent of it keeps our attention in order for us to begin to concentrate.

The study by Wickens and McCarley (Kramer et al. 2007: 171) explains the different kinds of attention, various theories on how people select an attention target and how we

can improve our concentration. Although many of their hours were spent analysing the attention needed for flight controllers, their findings can be applied to other fields as well. The selective attention model however that has been most widely applied is the structure-specific resource model of Wickens (1980: 571). His initial model had three dichotomous resource dimensions:

- along the information processing stages, perceptual and cognitive processing resources were proposed to be distinct from those supporting response processing;
- spatial processing resources were considered distinct from those needed for verbal processing; and
- separate resources for the different input (visual and auditory processing) and output (manual and speech processing) modalities were postulated.

Structural and capacity theories of attention and time-sharing are contrasted in Wickens (1980: 572) and Kellman et al. (2001: 220). Attention and time-sharing are then elaborated to describe the quantitative relation between resources and performance, and the representation of dual task data by the performance operating characteristic within a resource framework. Invariably, one task becomes automatic while one selects a new task or a more interesting task to attend more closely to. There are deficiencies with a single resource model of time-sharing. A specific model defines resources by stages of processing, codes of processing and modalities of encoding.

Wickens (Kramer et al. 2007: 172) outlines the relation between multiple resources and operator performance strategies and different measures of operator workload. More than one operation can therefore be selected and attended to at the same time as

multiple stimuli are acknowledged but these will not all be given the same attention and will therefore not all require the same work.

2.3 A GLANCE INTO THE TECHNO-WORLD OF TODAY

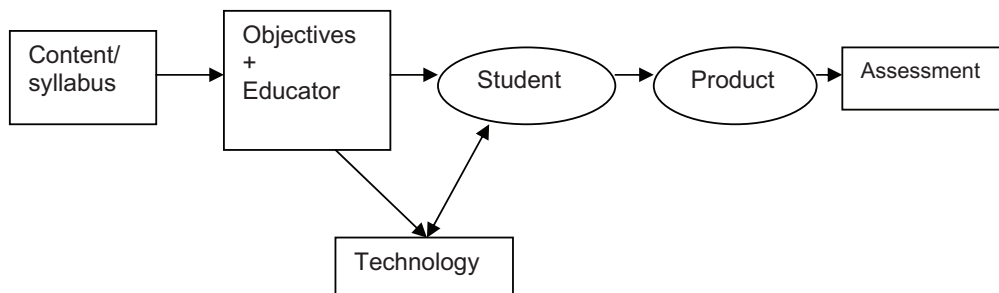
Our present day learners are engaged with learning in an environment that has shifted from the one in which we, as educators, were raised. It is therefore necessary to take a look at the technological world in which learners find themselves today.

Prensky's (Willoughby & Wood, 2008: 106) belief is that the high school experience, in particular, is a source of profound boredom for many teenagers who are usually engaged in some form of technology. The British Institute for Learning and Development recently adapted a slogan from a teenager who was overheard saying "When I come to school I have to power down"! Prensky (Willoughby & Wood, 2008: 106) argues passionately that students want engagement at the same level they gain from computer games in their learning. Present day students are more used to absorbing information from the screen than from the printed page, and they find teachers who use technology to be more reliable and knowledgeable than those who don't (Lytras et al. 2008: 189).

Teachers need to keep in mind that they are preparing to teach in the 21st century and that they are teaching 21st century children who have become accustomed to 21st century technology. While a teacher today is perhaps best described as a digital immigrant, the students are more appropriately described as digital natives (Niess et al. 2008: 4). Teachers remain the link between learning and the learner. The way in which they prepare their lessons and capture the attention, motivation and concentration of the learner is of the utmost importance. Teachers are keys for assuring educational reform

that adequately prepares students to meet the challenges of the twenty-first century (Niess et al. 2008: xiv)!

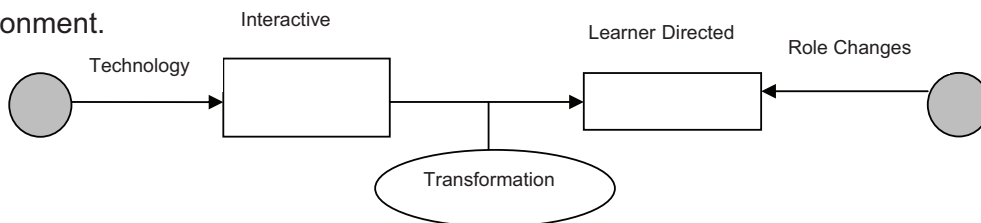
Many teachers are however making use of technology in the classroom but merely as an added resource and therefore the teacher is still directing the learning. This can be seen in figure 2.2.



(Adapted from Newhouse, Clarkson & Trinidad 2002: 22)

FIGURE 2.2: THE TEACHER-DIRECTED LEARNING ENVIRONMENT WITH TECHNOLOGY ADDED

Figure 2.2 which could possibly be seen as a teacher-directed technology theory, is in direct contrast to figure 2.3 which is more of a technology-directed theory, where the learner is actively involved and in control of his/ her learning environment. In figure 2.3 technology is used in such a way that the learner is actively involved in the process of learning. The learner’s attention has been attracted, possibly due to the teacher speaking the learner’s “language” and their concentration and focus is on the learning environment.



(Adapted from Newhouse et al. 2002: 22)

FIGURE 2.3: THE INTERACTIVE LEARNING ENVIRONMENT WITH TECHNOLOGY ADDED

Today's learners are used to constant stimulation and instant gratification and the material is better understood and better learned if learners receive instant feedback (Lytras et al. 2008: 189). We know from a regular classroom setting that teacher's intervention as and when an error occurs, is far better than an assessment later, when no instant feedback is given. The attention of the learner is then immediately captured. This is often not possible in regular classrooms.

The effects of technology on reading comprehension as learners tend to be more intrigued with the visuals and animations offered by the use of technology, was also investigated. Students have higher comprehension scores after reading electronic stories versus reading printed texts (Bitter & Legacy, 2008: 152). The interactive effects of sound, animation, narration and additional definitions that make up electronic texts, motivate students to want to read the stories again, which happens less often with printed text. The ease of access is also advantageous to the reader. Good designers of computer software are practical theoreticians of learning, since what makes games and other fun software, is that players are exercising their "learning muscles", though often without knowing it and without having to pay overt attention to the matter (Willoughby & Wood, 2008: 46).

A few theories related to the techno-world of today will now be discussed.

2.3.1 The Multimodality Theory

The multimodality theory, which is founded on Halliday's "social semiotic theory" of communication by Kress and van Leeuwen (Jewitt, 2006: 3), allows one to focus on all the different resources that are displayed on the computer screen and are part of classroom interaction. The main idea that underpins social semiotics is that language is

social. When students use multimodal computer applications they are engaged with a range of resources and they work with all the modes present on the screen and around it, not only from written words and speech. The learners are therefore stimulated by animation, colour and sound, and often have a time factor to take into account as well. Learners multi-task without even realising that they are engaging a number of senses. Simultaneously they are being stimulated by a number of senses as well. In this technology-rich learning environment, students can explore new information, construct new knowledge and link theories into practice (Khine & Fisher, 2003: 37).

Research evidence by Smith et al. (John & Wheeler, 2008: 48) highlighted a number of themes that emphasized the potential benefits for teaching and learning in classrooms when making use of multimodalities:

- Flexibility and versatility
- Multimedia/ multi-modal presentation;
- Efficiency
- Supporting planning and the development of resources;
- Modeling ICT skills;
- Interactivity and participation

As educators, we need to constantly expand our teaching repertoires and this technology-rich constructivist learning environment suggests that this mode of learning can be successfully used in teacher education (Khine & Fisher, 2003: 37).

In terms of student learning, the Becta study conducted by John and Wheeler (2008: 48) also emphasized that Interactive White Boards used in the classroom can:

- Increase motivation;
- Reduce the need for note-taking;

- Limit cognitive overload;
- Accommodate different learning styles;
- Enable creativity;
- Increase technological access for younger children

In addition, the Interactive White Boards, which are an extension of the computer in the classroom but have the ability to become interactive, as the name suggests, allow the student the opportunity to become fully involved in his/ her learning environment which automatically engages him/her fully in the classroom. In addition, the teacher can predetermine the learning material and can ensure that the prescribed curriculum is followed. The pace, however, is often determined by the learners.

2.3.2 The Activity Theory

The activity theory, which builds on the cultural historical approach to learning of Vygotsky (1965: 383), offers a useful framework for situating people's semiotic choices and use of technologies within the context of a curriculum subject and the classroom. It moves away from the idea of the individual learner engaged with what is represented on screen to suggest a more complex view of learning to ask how technologies mediate activity. In other words, the essence behind what really attracts someone to engage in an activity while making use of technology. This "Activity Theory" (Jewitt, 2006: 23) provides a framework for thinking about the interconnection of modes, the process of meaning making, learning and social context. How technologies are to be 'blended' effectively becomes urgent for teacher education.

2.3.3 A Socio-cultural view

In recent years, technology has come to refer almost exclusively to electronic technologies that provide information or entertainment. Yet, the term has multiple meanings and can be used in multiple ways.

A socio-cultural view of technology holds that tools are used to mediate or affect human activities (Parker, 2008: 215). From an educational perspective, classroom technologies could also include otherwise traditional items such as chalkboards, chalk, pen, paper and textbooks, as well as computers and other electronic tools that help children learn. Kern (2006: 142) lists three kinds of electronic technologies based on function: tutors that provide instruction and feedback, tools that provide access to second language materials and references and medium that includes sites for communication and distance learning.

2.3.4 A Scientific Approach

Willoughby and Wood (2008: 16) presented seven criteria on how to take a scientific approach to the issue of children's learning in a digital world:

- Taking a learner-centred approach rather than a technology-centred approach
- Focusing on promoting cognitive activity rather than behavioural activity
- Focusing on clear learning outcomes rather than nebulous goals
- Supporting evidence-based practice rather than speculation-based practice
- Providing research evidence that is methodologically sound rather than unsound
- Providing research that is theoretically grounded rather than ideological
- Providing research that is educationally relevant rather than irrelevant

Modern technology is an important example of a cultural tool that can be used to support learning in both scaffolding and co-constructing relationships. The learner-centred approach is the key to attracting the learner's attention as it allows the learner to become an integral part of the learning. By making use of technology and other

stimuli that attracts the learner, they will be enthusiastic and motivated to be a part of this dynamic environment.

2.3.5 The Constructivist Theory

Constructivism is a learning theory premised on the understanding that people are participants in their own learning. There is no single true reality that must be imparted to learners, but rather individuals create their own knowledge based on how they relate new information to what they have previously experienced (Bitter and Legacy, 2008: 143). Social constructivism additionally recognizes the value of social interactions in the learning process, meaning that people clarify personal conceptions as they interact with the understandings of others.

According to the “constructivist theory”, in order for teens of today to participate in their learning, their life-world needs to be included in the lessons. This means that technology needs to be included in the classroom in order for a constructivist approach to succeed. This approach relies on the following fundamentals:

- Constructivism: students are active learners
- Higher forms of thinking develop from experiences with more competent other persons, who serve as scaffolding for learning
- Higher forms of thinking develop from experiences with peers who co-construct learning outcomes
- Cultural tools and artifacts play a formative role in the learning processes
- The quality of discourse is an important factor in the quality of learning

Engaged learning is tied closely to constructivist underpinnings. Students learn best when they are active participants in the learning process, meaning that they make their

own decisions, think critically about real learning problems and resources and operate in contexts that are meaningful to them. Authentic, challenging and multidisciplinary learning tasks allow students to grasp the subject matter better.

2.4 CONCLUSION

The trend in the theories of attention seems to have depended on the history of psychology as a whole. The general movement was from a content psychology (consciousness) to a functional psychology. The emphasis on attention therefore moved from perception to learning and then on to motivation and finally to neurological and brain functioning.

Factors which have thought to influence concentration, according to the theories, include a variety of aspects for example the home, interpersonal relationships, routine, health, emotional development, work ethic, the teacher's standard of work, keenness to perform, ability to persist and a host of other complicated issues. It seems as if, however, an entirely new dimension has been added with the advent of technology.

Learners of today seem so familiar with various forms of technology that anything else seems mundane and unable to capture their attention and maintain their concentration. The value and strength of technology-based learning environments as a medium focuses on the versatility of the technology and the extent that they capture the learner's attention and sustain their ability to concentrate. It seems as if this has opened a 'gap in the psychology market' in so far as attention, motivation, concentration and focus are concerned.

3. ANCHORING ATTENTION AND CONCENTRATION THROUGH TECHNOLOGY IN THE CLASSROOM

3.1 INTRODUCTION

**Tell me and I forget, show me and I remember,
involve me and I understand.**

Chinese proverb

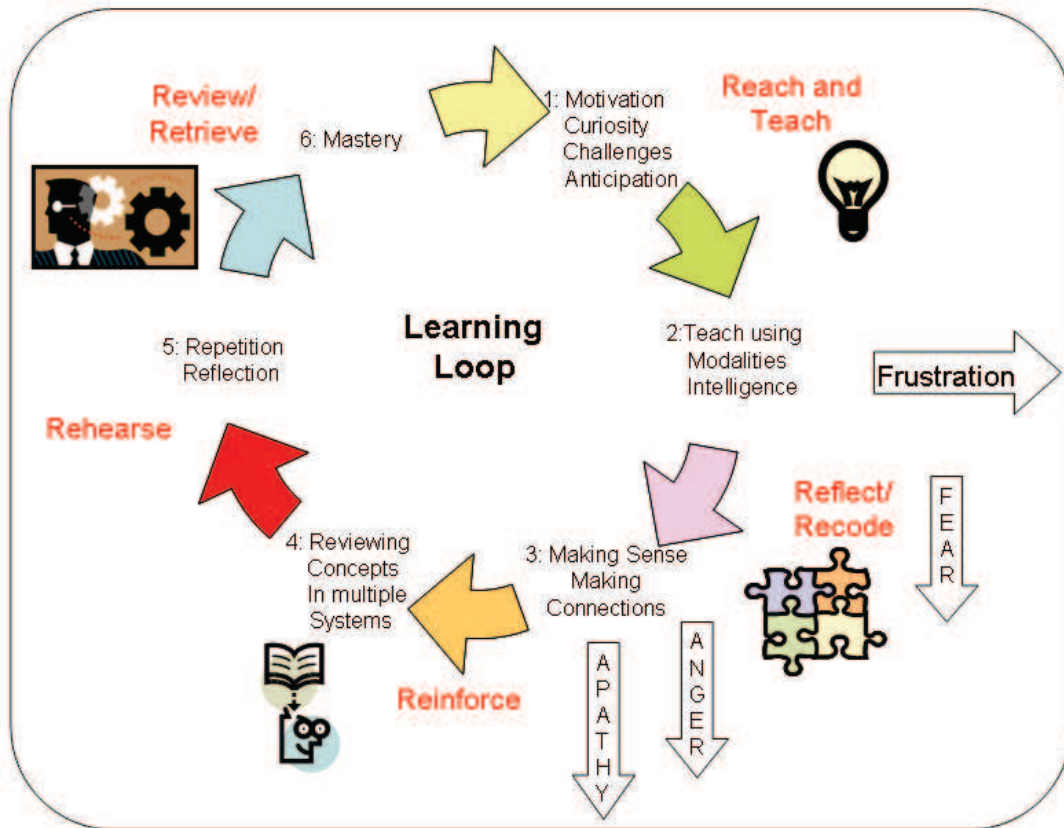
The intrigue for concentration initially grew out of the practical needs of the military in World War II. British naval commanders were concerned that the men monitoring the radar screen for enemy U-boats were becoming tired after long shifts, and consequently missing enemy attacks. They called on psychologists Craig and Mackworth (Mackworth, 1944: 586) to test the officers to figure out what would be the optimal amount of time that the radar operators could view the screen accurately. Craig and Mackworth (Mackworth, 1944: 586) had the subjects try to detect a signal that was presented on a screen for a split second. They measured the accuracy with which their subjects could detect the signal. The researchers found that vigilance, as measured by the subject's ability to detect a signal, is optimal at the beginning of the operator's shift and gradually wanes as the shift progresses (Mackworth, 1944: 586). Mackworth's pioneering research has been replicated time and again and tweaked for classroom application.

Craig and Mackworth's research led to many psychologists becoming interested in the topic of attention, concentration and focus. Theories grew and research became more prevalent. Educationalists became particularly interested in the learners' concentration in the classroom in order to maximise the learning environment.

3.2 ATTENTION IN THE CLASSROOM

There is no single item that captures the attention of students at school. Student's motivation to focus changes from day to day, hour to hour and even moment to moment, making the education environment difficult for teachers to sustain (Rinne, 1997: 39). In other words, "if you do not know what the fish are biting on today, try a variety of baits and use them all at once" (Rinne, 1997: 39). Any keen fisherman will arrive at the fishing spot with a grocery cabinet filled with 'goodies' to entice the fish. By a process of trial and error, he will eventually discover the flavour of the day and will begin to reel in the bites. If a teacher can stimulate students' thirst for learning, students are likely to pursue learning on their own (Barr & Parrett, 2008: 196).

Cohen (1976: 210) acknowledged the difference between attention-getting tasks (focus of attention) and attention-holding tasks (concentration). A teacher needs to arrive prepared with as many intrinsic appeals in each lesson as possible, and rely on probabilities to capture and hold student attention (Rinne, 1997: 39). A teacher must not think that once a learner's attention has been grasped, that this will be maintained throughout a lesson. Neither should one presume that this attention will automatically lead to concentration. According to Hale and Lewis (1979: 101) short tasks, built around concrete, personally relevant problems keep the student alert and active. As Sprenger (2007: 150) aptly states, if we want our students to learn what we are teaching, we must be aware of their states and manage them.



(Adapted from Sprenger, 2007: 156)

FIGURE 3.1: THE LEARNING LOOP

With reference to figure 3.1, the lesson is developed through various modalities, starting with a positive state which may include curiosity, anticipation and challenge. This is introduced by the teacher with some novel form of attention getting stimuli. It may require a variety of forms of stimuli before the teacher feels that the learners are paying attention. If learners fail to stay in the loop until they master the skill or content being taught in the lesson, they generally become frustrated with the initial teaching strategy and often see no significance in the lesson. It is important to get them back in the loop during the process. Otherwise, rehearsal and review of the lesson will be meaningless and make things more difficult for both the teacher and the learners concerned.

The idealistic suggestion of all learners being focussed on every lesson, in overcrowded classrooms, is not an easy task and is often an emotionally draining mission which is not fully understood by the general public who tend to carp about short working days and long holidays of the teachers, who are rarely viewed and respected as professionals by the general public and the learners (O'Flynn et al. 2003: 2). A glaring problem with contemporary educational institutions, which became apparent, was that they become fixed in mono-modal instruction with homogenized lesson plans, curricula and pedagogy and neglect to address challenging political, cultural or ecological problems or fail to attract the learners in their worldly-ways (Trifonas, 2008: 54).

Salthouse and Prill (1983: 617) investigated age-related divided attention effects in concurrent versus isolated memory span tasks which presumably impose greater demand on processing resources compared with bar-marked detection tasks. In this study, age-related divided attention deficits were obtained, prompting Salthouse and Prill (1983: 621) to conclude that task complexity is the key determinant of age deficits. In other words, the more difficult or complex a task, the more one is required to concentrate and this concentration span increases with age, at school going level. A similar conclusion was reached by Matthews, Davies and Westerman (2000: 296).

A learner's capacity for attention leading to their ability to concentrate depends on factors which include commitment and enthusiasm for the task, skills at doing the task, emotional and physical state, psychological state, and the learner's educational and home environments. When a teacher is dealing with a classroom filled with a diverse group of children, it would be near impossible to take each of these factors into account for every child in order to optimise the learning environment. The only way that

education can, however, be a success is to involve all the stakeholders and therefore total involvement of the teacher is required to produce total involvement of the child (Smith, 2005: 187). The fact that the learner needs to be actively involved with the lesson, making decisions, solving problems and coming up with viable solutions cannot be underestimated (Bitter & Legacy, 2008: 286). It is important therefore that if learners find modes of attention seeking and classroom activities outdated, educators should seriously consider matching the appropriate use of technology with content to maximize the student's potential in learning (Khine & Fisher, 2003: 22).

The growing population of young technology fanatics expects their teachers to offer learning opportunities in exciting and engaging formats according to Jones (2003) and Bitter and Legacy (2008: 287), as well as the fact that the learners would then have more control and responsibility over their own learning. Teachers are beginning to understand that technology not only brings fun to learning but also provides excellent situations to interest students in learning. While reading on a miniature screen seems unworkable for many adults, it appears that children don't regard it as difficult (Jonassen, Howland, Marra, & Crismond, 2008: 30). In table 3.1, the engaging elements of technology have been outlined. The mere fact that technology is seen as fun, adds an element of enjoyment to the learning material. The rules and requirements are generally well explained and formulated and are available for the learners to reread at any stage. The learners enjoy the instant feedback which they receive during the interaction, and learn from the constructive input which is displayed from mistakes made.

TABLE 3.1

THE ELEMENTS THAT MAKE TECHNOLOGY ENGAGING

The Elements that make Technology engaging:	
Characteristics of Technology	How characteristics contribute to players' engagement
Fun	Enjoyment and pleasure
Play	Intense and passionate involvement
Rules	Structure
Goals	Motivation
Interaction	Doing (i.e., the activity)/ social groups
Outcomes and feedback	Learning
Adaptive	Flow
Winning	Ego gratification
Conflict/ competition/ challenge and opposition	Excitement (fuelled by adrenaline)
Problem solving	Sparks creativity
Representation and a story	Emotion

(Adapted from Prensky, 2001)

To some extent, constant technological transformation renders necessary the sort of thorough restructuring of education that radicals have demanded since the Enlightenment of Rousseau and Wollstonecraft through Dewey, all of whom saw the 'progressive reconstruction of education as the key to democracy' (Trifonas, 2008: 47). Teachers need to be constantly on the lookout for new methods which excite and attract learners in the classroom. If technology is the "language" of today's teens then teachers need to make use of this "language" in order to engage the learners in the daily classroom activities and through this anchor attention and concentration in the classroom.

One of the main tasks of the teacher, which often only becomes apparent with experience, is to discover the latent appeals in the lesson content and reveal these to the students (Rinne, 1997: 29). The key is to ensure conditions are as suitable as possible for learning to take place.

Fisher and Khine (2006: 199) found that when teachers provide a positive classroom environment, students respond in a meaningful way, enhancing motivation and increasing achievement outcomes as a natural by-product. It is a ricochet effect – the more aware the teacher is of the type of classroom which attracts and engages the learners, the more motivated the learners become and they become more willing to work. This can be likened to a visit in a home with warmth, appreciation and an environment conducive to entertaining the visitors. People will want to return and reciprocate the feelings. The teacher therefore needs to gain control of his/her classroom and to exercise this control in a positive, firm and endearing manner in order for the students to know that the teacher is “with-it” but at the same time “is not a pushover and is well aware of what is happening in the classroom” (Lemlech, 2004: 134). To truly leave no child behind therefore requires significant professional development of school leaders and classroom teachers to build the necessary capacity to accomplish this task (Barr & Parrett, 2008: 336).

3.3 FOCUSING OF ATTENTION

A normal work attention span is documented at 3 to 5 minutes per year of a child's age. If one therefore deals with children of 13 years old, it would be expected for them to concentrate for at least 39 minutes, which in many schools almost constitutes a 40 minute period. A child entering preschool should be able to concentrate for at least 15 minutes (Allen: 1999).

This of course is possible in the first lesson of the day and perhaps the most exciting lesson during the course of the periods. However, is it possible for learners to continue concentrating hour after hour and simultaneously select the correct focus of attention intended by each teacher?

Many teachers work on what is known as the 10, 3, 7 system. This is interpreted as follows. 10 minutes are available for the first focus which is followed by 3 minutes of diffusion time. 7 minutes of a second focus time follows shortly after this. Souza (Sprenger, 2007: 152), agrees with the 10, 3, 7 concept and refers to what he calls the primacy-recency effect. He believes that 20-minute lessons with downtime are the most efficient. In a 20-minute learning experience, there is about 13 minutes utilised for prime time learning, 2 minutes for down time and a second prime time of about 5 minutes. Sprenger (2005: 127), however, argues that most learners are lost after 10 minutes of prime time learning in which case their attention is shifted and the activity needs to be changed. A recent survey conducted by Lloyd's of London in 2008 shows that the attention span of average Britons have plummeted from 12 minutes a decade ago to five minutes and seven seconds. Those over 50 had, in fact, a much better attention span than that of younger groups and school going ages (Thaindian News: 2007).

Student's attention needs to be immediately focussed on a particular lesson's content (Rinne, 1997: 131) by posing questions, by making statements, starting demonstrations or by announcing goals. Although the senses work overtime to provide as much input as possible, there is a bottleneck in the brain's limited capacity for attention (Stafford & Webb, 2005: 123). However, by ensuring an initial appeal for the lesson, the teacher has attempted to attract every child's attention in the classroom. The teacher often

creates a higher success rate by making use of bizarre and extreme introductions to the lesson. The presence of technologies in both formal and informal contexts makes them a particularly salient learning tool (Willoughby & Wood, 2008: 11). Willis (2005: 32) states that good teachers can and do stretch their students' brains by first stimulating their imaginations and interest to captivate their attention.

The quality of life lived in the classroom determines many of the goals that we hope to achieve from education (Goh & Khine, 2002: 6). This ultimate goal of education was ratified by Fisher and Khine (2006: 2) who stated that the classroom environment in schools is a significant determinant of student learning and backed-up by Robert Marzano's findings where students cannot concentrate in a chaotic, poorly managed classroom (Marzano, Pickering & Pollack, 2006: 121; Mack-Kirschner, 2005: 10). One of the teacher's many tasks is to create a learning environment conducive to learning!

Considerable research suggests that students pay attention to print, online, multimedia and interactive materials in distinct ways. Attention, focus, motivation and depth of understanding all vary depending on format. Visual materials tap different brain areas to verbal materials. Interactions between format and understanding are, however, not clear-cut. Interactive materials including animations can benefit students if the interactions involve making sense of relevant information, but interactions with electronic games and films often draw attention to irrelevant information as well (O'Donnell et al. 2006: 76). It is however still the student who must conform to the demands of formal education, and unfortunately due to a number of constraints, not the education that needs to conform to the student. The learning styles and strategies developed as a result of being part of the digital generation often have to be sacrificed

to the requirements of reading textbooks, listening to lectures and raising hands when the teacher asks for a response (Willoughby & Wood, 2008: 106).

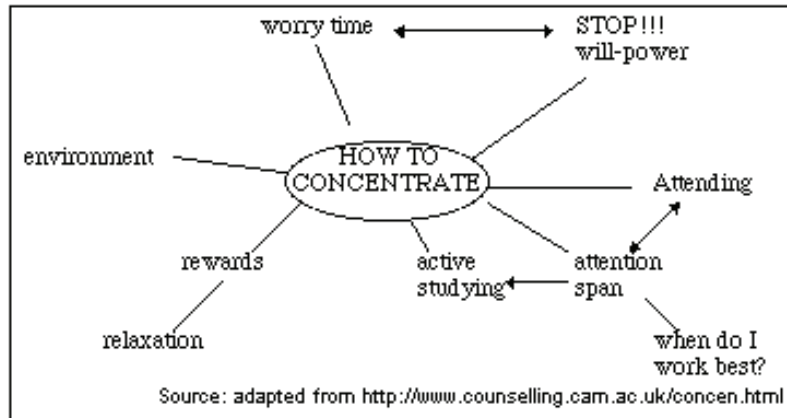
Observable differences have been noted between the previous generation of learners and today's techno wizards. A table has been drawn up to outline these differences. A very real difference can be seen in the need for stimulation. Where the previous generation saw stimulation and the need to attract attention in a slower pace, today's techno-wizards crave stimulation and expect immediate feedback.

TABLE 3.2
**OBSERVABLE LEARNING DIFFERENCES BETWEEN PREVIOUS
GENERATION AND TODAY'S TECHNO-WIZARDS**

	Previous Generation	Techno Wizards
Independence	Dependent on teacher to define and support learning	Independent problem-solvers and self-starters
Technology	The computer is a 'nice to have'	Technology is a 'must have'
Stimulation	Slower pace: it's ok to wait. Gaming is not a serious occupation.	Crave stimulation, expect immediate answers and feedback
Relevance	Learn 'what' or 'how' first, then find out 'why'	What's in it for me?
Lifelong learning	Work in the same organisation for life	View job environments as places to grow; have portfolio careers
Learner control	Teacher focus expected	Learner wants more autonomy
Comfort with unknown	Discomfort is avoided	Techno-wizards are fearless, hand-holding is not expected

(Adapted from Di Paulo, 2006: 126)

3.4 DEVELOPING CONCENTRATION



(Adapted from www.counselling.cam.ac.uk)

FIGURE 3.2: MIND MAP ON HOW TO CONCENTRATE

The art of concentration is reflected in the mind map in figure 3.2. Distractions need to be blocked out in order to devote maximum attention to the task at hand. This skill is acquired through practice and commitment. Initially rewards reinforce the paying of attention to the correct stimulus. If attention is held for prolonged periods of time, concentration sets in and focus can be maintained on the lesson and new material retained. When lessons are enjoyed and the presentation of the material is unique and well executed in the classroom, then concentrating becomes a far easier task than when a learner is tired, bored or completely disinterested in a subject. Learners have to make a conscious effort to focus attention on the task at hand. Concentration therefore involves decision making (Kramer et al. 2006: 31). Folk, Remington and Johnston (1992:1030) as well as Folk, Remington and Wright (1994:320) concluded that a feature will only capture attention if that feature shares some property consistent with the current goal of the observer. This is an important aspect in teaching. A distinction can be made here between bottom-up or stimulus driven attention which relies on the visual properties of the stimulus, versus the top-down or goal-driven stimulus where the

learner is pre-warned of the necessary requirements, much like the rubrics which are often used in today's school system.

Children find concentrating very difficult if they do not understand the concept under discussion or similarly if they find the concept too easy and therefore are encased with boredom. Teachers need to keep the learners constantly in mind when preparing lessons. Vygotsky identified a zone which he referred to as the zone of Proximal Development (Mack-Kirschner, 2005: 6) which was aimed at targeting learning. This zone is somewhat above what students already know; enough to challenge them but not so far above what they already know or are able to do that they are frustrated and give up (Mack-Kirschner, 2005: 6). Vygotsky described the zone as a window of opportunity for the learner to engage in the learning process (Niess et al. 2008: 49). This theory of Vygotsky, together with that of Bruner emphasise an individual constructing his/her own understandings (Niess et al. 2008: 49). Children's personalities and identities, shaped in so many ways by new technologies, are not given much room to develop within the more confining environment of formal learning and they tend to give up on learning (Willoughby & Wood, 2008: 106).

Studies show that learning is enhanced when students become actively involved in the learning process (Mack-Kirschner, 2005: 101). Therefore all parties within the educational spectrum must be involved in the lessons so that 'power is distributed across actors' (Van Note, Chism & Bickford, 2002: 10). If the children are involved and not given an opportunity to lose interest, maximum learning will take place. To live, learn and work successfully in an increasingly complex and information-rich society, students must be able to use technology effectively within an effective educational setting (Niess

et al. 2008: 40). Technologies that provide interactivity, learner control and student engagement are a natural choice for improving instruction (Shelly, 2004: 6.12).

Studies conducted by Brophy and Good (1986); Cazden (1986) and Erickson (1973) (Fraser and Wahlberg, 1991:196) were aimed at establishing the cause and effect of teacher's and student's interaction on the ability of the learners to attend to the lessons. These researchers attempted to examine how students and teachers jointly collaborated in the construction of the learning environment (Fraser & Wahlberg, 1991:196). Observable factors which were taken into account included posture, head and torso orientation and position. These are often used as clues by the teacher to define which learners are attending to the lesson and which are clearly not. The findings concur that teacher eye-contact with students maintained the attentiveness of the learners (Fraser & Wahlberg, 1991: 196). No assessment was, however, carried out in order to ascertain whether or not the learners actually gained anything of value from these lessons. Perhaps attention researchers should not only think about what features capture attention, but when these same features fail to capture attention (Kramer et al. 2007: 43).

While teachers are only too aware of the limitations to human attention and know that sooner or later, something will go wrong during the lesson and student attention will be distracted from the content of the lesson (Rinne, 1984: 258), the teacher hopes that at some stage during the introduction of a lesson that something will appeal to each learner, and he/she will be motivated to at least try and eliminate inappropriate or unimportant stimuli (Willis, 2005: 34). Many students, however, find it very difficult to stay on task for any length of time. The classroom atmosphere, time of day and state of

the learner can all play a role in their ability to concentrate. Like a good shepherd, the teacher, from time to time in the lesson, may need to gently, but firmly, call back his straying flock (O'Flynn et al. 2003: 76).

Teaching is an extremely demanding task and experience proves that what works in one class may not work in another class. In the teacher's best interests he/she needs to know the requirements of a class and individuals within a class and learn these as early on as possible in order for results to be successfully measured. Teachers need to be perceptive towards the needs of the learners, so that he/she may know what works in each individual classroom in which he/she teaches. Technology needs are of paramount importance. Learners are accustomed to all forms of technology and require these in the classroom in order to maximise learning. Marzano et al. (2001: 19) suggest that how aware a teacher is of what is going on in the classroom and the state of the learners will make a big difference to the learning that happens in the class.

Sigman (2007: 17) pointed out that attention is the prerequisite to what we consider being alive. Our ability to pay attention in the classroom is the one characteristic that allows learners to be part of the school system and to learn in a formal manner, setting us at the top of the food chain. It is strange, however, that this same ability needs constant reinforcement and continual stimulation in order to work at a maximum pace, speed and interest level. Children today, seem to battle to pay attention for any length of time, remaining passive in their world of instant gratification and technology. Their attention to something needs to be frequently rewarded or they seem to lose concentration and interest (Sigman, 2007: 26). Choosing what to give attention to is

mostly voluntary according to Stafford and Webb (2005: 123), however attention can be captured but in order to maintain the interest level, children must find something in the lesson for them (O'Flynn et al. 2003: 111).

Jimenez (2002: 148) examined how the instructions given to learners in a classroom and their subsequent state of attention would affect the learning environment and the learner's ability to grasp a concept with particular reference to serial and abstract structure. Although learning took place in both the control and the experimental groups, a clear difference could be seen in the response time of the learners who had not been given clear instructions and explanations. Subjects in explicit conditions with stimulated environments therefore demonstrate a clear advantage (Dominey, Lelekov, Ventre-Dominey & Jeannerod, 1998: 750). When instructions are given in a captivating way, learners will follow and tend to be more vigilant to the task. If technology is included in the initial appeal, there is more chance that the learners' attention will be captivated and maintained.

If students' attention is not captured and held, they will misbehave in order to satisfy their need for power, fun, freedom and belonging according to Hargreaves (O'Flynn et al. 2003: 119). Teachers must, however, ensure that there is not an over-emphasis in schools nowadays to have fun – often to the detriment of learning. While school is intended to fulfil more than an academic void in a learner's life, it cannot be seen as all fun and games. It should be appealing and interesting without being irrelevant often leading to dead-time in the classroom. It should also be the time when learners are trained for later life, in the work-place, where they are expected to pay attention in

meetings and while executing their jobs. Therefore a teacher's job includes engaging students in learning and thus educators consistently ask whether students have learned what they need to learn to be productive citizens (Niess et al. 2008: 49).

21st century children are hooked and captivated by technological gadgets. If one travels past poor communities in rural areas in South Africa, the one identifiable feature is the TV aerial sticking in between metal structures and make-do homes. It seems that TV is the one enjoyable common aspect of almost all children today. However, the findings of Krugman (Sigman, 2007: 93), conclude that within 30 seconds of turning on the television, our brain becomes neurologically less able to make judgements about what we see and hear on the screen. We go into a state which is passive and yet stimulating due to all the activities and sounds which happen constantly on the screen. This type of concentration is familiar to our learners. Hours can pass and they have managed to remain focussed on the stimulus and their concentration remains engaged on the topic. At school, however, far removed from this familiar setting, learners are expected to sit and concentrate on the lessons in the classroom. The level of concentration and activity that the learner is used to while at home is far more intense and complicated than that which is nowadays required at school, unless learning is built on notions of flexibility, accessibility, immediacy, interactivity and adaptability (Tsang et al. 2007: 11).

Children are extremely used to continual movement, sound and flashing images frequently supplied by technology. Suddenly they find themselves in a school situation where they spend a great deal of their youth behind closed doors, in a classroom which is often bare, plain and uninteresting. Teachers who know how to capture and hold the attention of their students, can generate excitement and a creative learning environment

where they can become critical thinkers who not only master standards and the associated tests, but who make connections, form judgments, and offer critical analyses (Willis, 2005: 30). Piaget reiterated how the teacher functions as a guide, a demonstrator, or a facilitator who brings helpful materials into focus by capturing the attention of the learners and therefore empowers the child to discover knowledge (Smith, 2005: 128).

There are not as many different types of student activities as we might imagine; the technique is to shift rapidly to a new activity if one does not hold student attention or is not producing learning (Rinne, 1997: 131). It is important to try and capture both dominantly left and right brained learners in the classroom during a lesson. It is the teacher's responsibility to discover during education what each particular brain is good for and what appeals to the different brain types.

3.5 AN EFFECTIVE TECHNOLOGY-RICH CLASSROOM ENVIRONMENT

The effective use of technology in the classroom can only be managed and maintained when the educator rethinks the basic tenets, to deploy the new technologies in creative and productive ways and to restructure schooling to respond constructively and progressively to the technological and social changes currently underway for a hi-tech, multicultural society and global culture (Trifonas, 2008: 45). This entails the following in order to be a success in the classroom according to Bitter and Legacy (2008: 154):

- Students' active involvement in the learning process through activities such as problem solving and data analysis

- Collaborative learning activities that tend to increase student motivation, understanding and self-confidence
- Immediate and individualized feedback on performance

The material must therefore be presented in the context of real-world situations or through other authentic sources of information in order to maintain meaning and therefore capture the learner's attention in the classroom. According to Tiene and Luft (Bitter & Legacy, 2008: 67) students seem to focus on their work longer when using technology. It appears that technology will certainly drive the reconstruction of education, but we should make sure that it works to enhance democracy and empower individuals (Trifonas, 2008: 65). Just like books, I do not see the teacher disappearing any time soon. But I do see the need for change! Bitter and Pierson (Khine & Fisher, 2003: 22) view technology as an agent of change and appropriate use of technologies can make learning for students more interesting and enriching as well as prepare them for the demands of the workplace.

3.6 SUMMARY

The emphasis throughout the divergence of the literature review has led to the importance of understanding attention and concentration with a special emphasis on the learner of today in the 21st century. The following focus areas have been identified:

- The concentration and attention of today's learners in the classroom
- The effect of technology on the attention and concentration within the classroom context.

4. THE METHOD OF THE EMPIRICAL INVESTIGATION

**If the map shows a different structure from the territory represented ... then
the map is worse than useless, as it misinforms and leads astray.**

Alfred Korzybski

4.1 INTRODUCTION

This chapter outlines the research design used in the empirical study. The research carried out for the literature review has revealed the necessity to analyse learners' attention and concentration within the classroom and to analyse the possible effects that technology might have on this attention and concentration. As discussed in chapter one, the capturing of the learner's attention and the motivation of learners to concentrate in the classroom will therefore be under empirical investigation.

A randomly selected sample of typical learners was used in the empirical investigation. Information on the sample and the allocation of learners to the experimental and control groups will be discussed. A discussion will pursue on the measuring instrument including the items selected in the questionnaire. The lessons administered to the groups will be looked at, as well as the achievement tests which were completed by the learners at the end of each lesson.

In closing, the procedures used in the empirical investigation will be statistically analysed in order to ensure a high level of internal validity with regard to the research design.

4.2 HYPOTHESES

4.2.1 Hypothesis 1

There is a significant difference between the average achievements of a group of learners exposed to technology during a lesson compared to a group not exposed to technology.

Rationale

The literature study revealed a difference between the achievements of learners using technology compared to those not using technology (refer to sections 2.3 and 3.1) A study conducted by Bitter and Legacy (2008: 152), found that students have higher comprehension scores after reading electronic stories compared to those reading printed texts. Further studies conducted by Khine and Fisher (2003: 22 & 37) reveal that technology assists the students to make meaning of the material and educators must therefore match appropriate technology usage in order to maximise a student's potential learning. The interactive effects of sound, animation, narration and additional definitions that make up electronic texts appeal to today's learners, motivating them to higher average achievement. These findings are confirmed by Trifonas (2008: 45) who conducted studies related to the use of technology in the classroom. These studies show how achievement can be improved in the classroom with the active involvement of the students by restructuring schools and progressing lessons in classrooms towards making use of the technological advancements.

4.2.2 Hypothesis 2

There is a significant difference between the average attentions of a group exposed to technology during a lesson compared to a group not exposed to technology.

Rationale

According to the literature study (refer to sections 2.3, 2.3.1, 3.4 and 3.5) learners pay more attention when technology is present in a lesson. Khine and Fisher (2003: 37) link the attention of the learners to the technology-rich learning environment where students can explore new information, construct new knowledge and link theories into practice. Willoughby and Wood (2008: 46) noted that learning takes place on computer software without the learners realising the amount of attention they are paying to the material. Jewitt (2006: 23) provides a framework for what engages someone's attention while making use of technology and Bitter and Legacy (2008: 67) found that students seem to focus on their work longer when using technology.

4.2.3 Hypothesis 3

There is a significant relationship between the motivation of learners and their achievement.

Rationale

According to the literature study, a relationship exists between motivation and achievement of learners (refer to section 3.2). Fisher and Khine (2006: 199) found that when teachers provide a positive classroom environment, students respond in a

meaningful way, enhancing motivation and increasing achievement outcomes as a natural by-product.

4.2.4 Hypothesis 4

There is a significant relationship between the motivation and concentration of learners.

Rationale

The literature study revealed (refer to sections 2.2.2 and 3.4) a relationship between motivation and concentration of learners. Kounin and Gump (1974: 560) focussed their theory on a teacher's ability to motivate a student to concentrate when he/she sees the reward gained by a fellow classmate by making use of the ricochet effect. Conversely, Sigman (2007: 26) revealed that learners need to be motivated in order not to lose concentration and interest in the work.

4.2.5 Hypothesis 5

There is a significant relationship between the motivation of learners and their attention during a lesson.

Rationale

The literature study reveals that a relationship exists between motivation and attention (refer to sections 1.1 and 2.2.3). Shelly (2004: 6.08) established that technology has the potential to increase student motivation and class attention while Neisser's (1976: 44)

pre-technology theory found that experience plays a role in motivating a learner to attend to a lesson, as one becomes more adept at sifting out interesting material.

4.2.6 Hypothesis 6

There is a significant relationship between the concentration of learners and their achievement.

Rationale

According to the literature study a relationship exists between the concentration and achievement of learners (refer to sections 2.2.3 and 2.2.1). Broadbent (1958: 23) proposed that one would concentrate over a sustained period of time if new knowledge could be linked to what has already previously been achieved. Navon and Gopher (1979: 231) agree with Broadbent that one tends to concentrate fully when one can corroborate newly acquired information with what one knows and has already achieved. Eysenck (1981: 348) found a link between a person's ability to concentrate and their achievement in certain tasks.

4.2.7 Hypothesis 7

There is a significant relationship between the concentration of learners and their attention.

Rationale

The literature study has revealed a relationship between concentration and attention (refer to sections 2.2.4, 2.2.5 and 3.2). Studies conducted by Parasuman and Davies (Kramer et al. 2007: 157) suggested that the capacity to sustain attention deteriorates over time for certain tasks, suggesting that attention may, at times, not be sustained long enough to be recognised as concentration. Moray (1967) and Kahneman (1973) proposed that one's demand for attention is limited by the individual's concentration capacity. Wickens and McCarley (2002) spent many hours trying to explain various theories on how people pay attention and how they can improve their concentration. Cohen (1976: 210) acknowledged the difference between attention-getting tasks (attention) and attention-holding tasks (concentration).

4.3 RESEARCH DESIGN

An experimental investigation in the classroom was decided upon as the mode of inquiry for this study. The study was conducted in two phases. The first phase is a self-completion questionnaire which learners completed at school. This was followed by the second phase, consisting of a series of lessons where the experimental group was exposed to the lessons making use of technology in the classroom while the control group was given the same lessons but the technology was omitted during the administering of the lessons. Achievement tests were given directly after the lessons which were marked by the teacher and the results were filled in on the learners' questionnaire forms.

The chosen sample, the measuring instrument and the procedures followed during the empirical investigation will now be addressed.

4.3.1 The Sample

Today's teenagers are the target population in this study, as they are the "digital natives" who have been raised in the technological era. The target population of learners sought for the investigation fall in the 12 to 13 year old technologically active age group. They are at the beginning stages of formal operations according to Piaget's theory and are therefore outgrowing the concrete operational phase. The first year of high school was seen as an ideal age for the investigation. Permission obtained for the access to state schools is time-consuming and often rejected by one of the role players concerned.

For the purpose of this study, learners at an accessible independent junior college were approached to take part in the investigation. This independent school is situated in the Gauteng province, specifically located in Centurion. The college has two grade 8 classes consisting of 22 learners in the one class and 23 learners in the other class. The learners are randomly selected to the classes at the beginning of each school year, ensuring that the classes are not specifically streamed nor are they grouped according to any other criteria. The classes are therefore accepted to be analogous in every aspect.

Due to the relatively small sized classes in the school, non-probability sampling was used where the entire class became the sample. The classes were randomly assigned

to the experimental group (8M) and the control group (8J), thus making use of the static-group comparison.

4.3.1.1 Demographics of the sample

The sample can be viewed as representative and balanced. As can be seen in table 4.1, from the total grade 8 sample, 71% of the entire group speak English as a home language, while 16% of the group speak Afrikaans as a home language and 13% speak an African language as a home language.

TABLE 4.1

HOME LANGUAGE AND GENDER COMPOSITION OF THE SAMPLE

Group	English	Afrikaans	African language	Male	Female	Total
Experimental	16	3	4	12	11	23
Control	16	4	2	13	9	22
Total	32	7	6	20	20	45

In the experimental group, 70% of this group speak English as a home language, while 13% of the experimental group speak Afrikaans as a home language and approximately 17% of the experimental group speak an African language as a home language.

In the control group, 73% of this group speak English as a home language, while 18% of the control group speak Afrikaans as a home language and 10% of the control group speak an African language as a home language.

The gender composition of the sample group consists of 56% males and 44% females in the total group, as can be seen in table 4.1. The experimental group is made up of 52% males and 48 % females, while the control group consists of 59% males and 41% females.

4.4 MEASURING INSTRUMENT

4.4.1 Description, structure and justification of the measuring instrument

A questionnaire was decided upon as the measuring instrument for the investigation. Questionnaires collect data by asking people to respond to exactly the same set of questions (Saunders, Lewis & Thornhill, 2007: 394). Questionnaires are cost effective and economical to produce. An added advantage is that the recipient can remain anonymous. All respondents are offered the same options for every given question.

Several questionnaires used for the measuring of concentration and attention were looked at - Dorman, Alridge and Fraser (2006:908); Taylor (2002: 147 – 150); Dorman (2002: 128); Maor (1999: 321) and Bester (2004). It was decided to make use of a questionnaire which had been specifically designed for South African children (Appendix B). The items were altered to suit the needs of the study under investigation.

The sample group had ample time in which to respond to the questionnaire and therefore there was no pressure of time shortages. The questionnaire was designed to

elicit the learners' opinions on the lessons which they regularly attend, how motivated they are to attend these lessons and what methods they feel are effective and efficient in attracting their attention and in maintaining their concentration. The learners' questionnaire consisted of a demographics section in order to determine gender and home language of each learner. This was followed by 40 items in the self-completion section.

A 6-point Likert scale was used in the measuring instrument where 1 indicated complete disagreement while 6 indicated complete agreement.

4.4.2 Composition of the Measuring Instrument

Table 4.2 shows the item numbers for both constructs used in the survey. By totalling the response obtained for each item, a comparison can be made and calculated. A high total reveals a strong relationship with the identified factor while a low total reveals a weak relationship between the identified factors.

TABLE 4.2
DESCRIPTIVE INFORMATION FOR QUESTIONNAIRE

SCALE	NUMBER OF ITEMS	ITEM NUMBERS
Motivation	20	1, 4*, 5*, 6, 8, 12*, 13*, 16, 18*, 19*, 22, 24, 25, 28, 29, 31, 33, 34, 37*, 40
Concentration	20	2*, 3, 7*, 9, 10, 11*, 14*, 15*, 17*, 20*, 21, 23*, 26, 27*, 30 32*, 35*, 36*, 38*, 39*

Not all the items have been set in the same direction. For certain items, the scale needed to be reversed before the responses could be tallied. The items which need to be reversed have been marked with an asterisk (*) in table 4.2 above.

4.4.3 Reliability of the questionnaire

The reliability of a questionnaire gives an indication of its consistency. A reliable test when repeated should elicit similar results. To enhance reliability, all subjects should be given the same directions, have the same timeframe in which to answer the questions at the same time during the day (McMillan & Schumacher, 2001: 249). As mentioned, the initial section of the questionnaire was administered to both groups simultaneously

while the entire sample was all together in a venue and prior to any lessons having been conducted on the research. This meant that all learners received the identical information and instruction set prior to completing the questionnaire.

Established techniques (McMillan & Schumacher, 2001: 258), were used while developing the items, in order to enhance the reliability of the questionnaire.

- Simple items were composed to minimise misinterpretation.
- The items in the self-completion questionnaire were retested in the achievement tests in order to clarify the results.
- The questionnaire made use of a 6-point scale in order to augment objectivity and consistent interpretation.
- 20-items were created for each construct in order to guarantee reliability, due to the fact that the number of items in a questionnaire is directly linked to reliability of the survey.

4.4.4 Validity of the questionnaire

The validity of a questionnaire lies in the success of testing what it was designed to test. Validity is the single most important aspect of an instrument and the findings that result from the data (McMillan & Schumacher, 2001: 242). Four major types of evidence were looked at to support the intended interpretations and eliminate any opposing hypotheses about what is being measured.

4.4.4.1 Content validity

Attention was given to the following aspects, in order to ascertain content validity:

- Existing questionnaires previously used in similar research were analysed and relevant items were tweaked for use in this research.
- The questionnaire was based on several questionnaires previously used for the measuring of concentration and attention.
- The literature review was referred to while developing the questionnaire.
- The questionnaire was reviewed by competent readers to ensure that the items included were relevant for the current research.

4.5 PROCEDURES FOLLOWED DURING THE EMPIRICAL INVESTIGATION

The questionnaire was piloted at an independent school in Gauteng, in order to test the instruction set as well as the contents of the questionnaire. The pilot school is similar in structure to the actual school used in the research, therefore eliminating possible interfering factors. Slight alterations were made after piloting the questionnaire and a few of the items were reshuffled in order to ensure that they were randomly presented in the survey. The pilot study proved to be of great help in defining the relevant items.

- A pilot study was done to ensure the elimination of possible loop-holes and discrepancies.
- The pilot study was fundamental in testing the use of the questionnaire as well as the instruction set to be given to the learners. The assimilated circumstances, allowed an objective and constructive criticism to be carried out.

The initial survey was carried out with the sample together in one central venue, in order for the instructions to be consistent for everyone and in order to eliminate the possibility that time, weather conditions, length of time without food and other potential factors could weaken the results of the survey. This also eliminated the fact that learners could discuss the items and influence each others' results. Each item in the demographic section was explained and filled in simultaneously by the learners.

The filling in of the demographic section was followed by the 40 items of the self-completion questionnaire. No pressure was placed on the learners to complete the survey within a certain timeframe but rather the learners were told to read each item carefully and to think honestly about each item. The learners were given the opportunity to ask for explanations if items were unclear to them or if there was any uncertainty which arose over the questionnaire. All learners then received the benefit of hearing the further explanations. The learners completed the survey in pencil so that they could change any answers if they felt another scale was more appropriate when rereading and checking their answers. Approximately 30 minutes were taken to complete this section of the questionnaire. These questionnaires were then collected.

A series of three 40 minute lessons were then carried out over a period of a week in the following learning areas: Geography, English and Mathematics. The two grade 8 classes were randomly selected as the experimental group and the control group. Each learning area lesson was presented to both classes on the same day and in consecutive school periods in order to eliminate factors such as time of day, hunger and tiredness.

This also eliminated the learners discussing the lessons with learners from the other class.

The same lesson was presented to both classes during school time. One difference in the lessons prevailed: the experimental group was exposed to some form of technology during the lessons, whereas the control group was presented with no technology during the lessons. The identical content was administered to both groups and the same wording was used during both lessons. Attention is a difficult factor to measure as so many interfering factors could play a role.

In order to establish the attention of the learners, a short test became necessary. The identical twenty mark achievement test was given at the end of each lesson to both groups. 10 marks tested direct content of the lesson while the other 10 marks tested attention by asking questions which related to small details given during the lessons. The learners answered the questions individually and wrote the answers on the spaces provided in each test. Most questions required only single-word answers. The answers to the questions which were tested under the content section of the test were told directly as part of the presentation during the lessons, however the attention section incorporated questions which could only be answered if one was paying attention to the subject matter and details during the lessons, as they were subtly included in the presentation of the material.

4.5.1 The Geography lesson

The country of choice chosen for the Geography lesson was Vietnam. This country is not included as a 'country of study' in the South African Geography syllabus and this was therefore selected as very few students would have background knowledge to the country, which could taint the results. The experimental group was shown a 'power point presentation' connected from the computer to the visualiser in the classroom. This included visuals of the Vietnamese cuchi tunnels and the surrounding Vietnam countryside and people. The control group was given the identical information and lesson but had no access to the technology.

Both groups were administered the achievement test directly after the material had been presented and completed this individually in the classroom. The tests were collected and marked. These marks were written on the learners' questionnaires in the appropriate spaces provided on the form. A copy of the Geography lesson plan can be seen in Appendix C.

4.5.2 The Mathematics lesson

The Mobius strip was selected as the topic for the Mathematics lesson as once again it is not a commonly known section in Mathematics and is generally an unknown topic to Grade 8 learners. It was decided not to choose a pure Mathematical concept in order to ensure that all learners could participate and had equal chance of achieving during the test as the material did not rely on those who do well in Mathematics or who are good at figures and numbers.

A video clip of the Mobius strip was shown to the experimental group while the control group was explained the identical information but was not exposed to any form of technology and therefore did not view the video in any form. As the Mobius strip is spatial by nature, a practical demonstration in both groups resulted in each learner making a Mobius strip for themselves before completing the achievement test. The mathematics lesson plan can be seen in Appendix D.

4.5.3 The English lesson

An unseen English poem was explained to the learners during the English lessons. The experimental group was exposed to an auditory tape while expressive pictures, depicting the poem, flashed on the interactive SMART board. The teacher recited the poem to the control group who were given the same explanations but were not exposed to any form of technology during the lesson. Once again the achievement test was administered at the end of the lesson to both groups. The lesson plan for the English lesson is part of Appendix E.

During the administration of each test, every question was read out aloud, by the teacher in order to assist any learner who may have a reading difficulty and who may therefore misinterpret and misread the question. The answers were then completed by each individual learner of both the experimental and the control groups. The results of each individual achievement test were then collated and filled in on the learners' original questionnaire forms. These results were analysed statistically for interpretation purposes.

4.6 CONCLUSION

The planning and execution of the empirical investigation have been discussed in this chapter outlining the experimental and control groups selected, the measuring instrument and the procedures followed during the empirical investigation. The questionnaires used in the survey together with the results of the achievement tests have become the fundamental part of the data gathered in this investigation.

5. RESULTS OF THE EMPIRICAL INVESTIGATION

5.1 INTRODUCTION

The aim of the empirical study is to investigate the attention, motivation and concentration of learners in the classroom when lessons are conducted using a form of technology in comparison with the attention, motivation and concentration of learners when no form of technology is included in the presentation of the lesson.

The results from the tests administered after the three lessons, together with the results of the questionnaires were used in order to obtain data which could be processed to test the hypotheses formulated in chapter four (refer to section 4.2). Three learning areas were chosen and identical lessons were then presented to two groups of learners, an experimental group and a control group. An achievement test was administered at the end of each lesson.

The results of the survey as well as the test results will be analysed and discussed in detail. The results will be discussed in two parts.

Firstly, the psychometric attributes of the measuring instrument will be discussed, which includes:

- An item analysis in order to eliminate possible weak items in the questionnaire
- Computations of the measuring instrument's reliability

Secondly, the testing of the hypotheses, stated in chapter four (section 4.2) will be discussed.

5.2 ITEM ANALYSIS OF THE MEASURING INSTRUMENT

Two constructs were identified for investigation; that of motivation and concentration. The motivation section of the survey instrument was designed, based on previously accepted measuring instruments (as discussed in section 4.4.1). The items were modified to suit this investigation. Items were added to include a concentration section. An item analysis has been conducted separately for each construct.

Two aspects have been taken into account for the item analysis:

- The correlation with the total has been calculated. Suitable items will correlate positively with the total of the section. In the case of an item-total correlating negatively or weakly, the omission of the item will be considered.
- The reliability of each section has been tested by making use of the Alpha coefficient. If the omission of an item significantly raises the Alpha coefficient, the item can be disposed of; otherwise the item will remain part of the measuring instrument. The items that correlate positively and at the same time contribute to the reliability of the measuring instrument are retained.

Tables 5.1 and 5.2 show the results of the item analysis for each construct.

TABLE 5.1
ITEM ANALYSIS OF THE ITEMS FOR MOTIVATION

Total number of subjects	45	
Total number of items	20	
Alpha Reliability coefficient	0.902	
Item	Correlation with total	Alpha if item is omitted
1	0.641	0.894
4	0.648	0.894
5	0.663	0.893
6	0.366	0.902
8	0.755	0.890
12	0.333	0.902
13	0.425	0.901
16	0.384	0.901
18	0.509	0.898
19	0.404	0.901
22	0.560	0.897
24	0.661	0.894
25	0.414	0.900
28	0.630	0.894
29	0.391	0.901
31	0.563	0.896
33	0.619	0.895
34	0.534	0.897
37	0.690	0.892
40	0.616	0.895

As can be seen in table 5.1, all the items measuring motivation, correlate positively with the total of the section. Omitting any one of these items will lower the reliability instead of raising it. As a result, none of the motivation items have been omitted.

TABLE 5.2
ITEM ANALYSIS OF THE ITEMS FOR CONCENTRATION

Total number of subjects	45	
Total number of items	20	
Alpha Reliability coefficient	0.935	
Item	Correlation with total	Alpha if item is omitted
2	0.816	0.928
3	0.449	0.934
7	0.757	0.929
9	0.612	0.932
10	0.699	0.931
11	0.563	0.933
14	0.623	0.932
15	0.688	0.930
17	0.627	0.932
20	0.661	0.931
21	0.494	0.934
23	0.730	0.930
26	0.605	0.932
27	0.493	0.934
30	0.682	0.932
32	0.738	0.929
35	0.732	0.930
36	0.653	0.931
38	0.643	0.931
39	0.348	0.937

As can be seen in table 5.2, all the items measuring concentration, correlate positively with the total of the section. Omitting any one of these items will lower the reliability instead of raising it. As a result, none of the concentration items have been omitted.

5.3 RELIABILITY OF THE QUESTIONNAIRE

A measure is reliable to the degree that it supplies consistent results (Cooper & Schindler, 2003: 236). When a construct is measured, the raw score acquired is shown as the observed score. The observed score varies from the individual's true score as a result of an error component. It is accepted that whenever psychological constructs such as motivation and concentration are measured, that a measuring error will be present. The presence of an error component shows that the scores obtained on one occasion could vary on another occasion. A lower error component means that the difference between the raw score and the true score will be less.

It is therefore necessary to obtain a reliability coefficient as close as possible to 1. An acceptable minimum value of a reliability coefficient is 0.70 (McMillan & Schumacher, 2001: 245).

The obtained coefficients have been summarised in table 5.3 below:

TABLE 5.3
RELIABILITY COEFFICIENTS OF THE VARIOUS SECTIONS OF THE
QUESTIONNAIRE

SECTION	NUMBER OF ITEMS	RELIABILITY COEFFICIENT
Motivation	20	0.90
Concentration	20	0.93

N = 45

From the data obtained in table 5.3 one can draw the conclusion that the two sections in the questionnaire are reliable. The difference between the raw scores and the true scores is seen to be very small and therefore the error component is minimal in the questionnaire.

5.4 TESTING THE HYPOTHESES

5.4.1 Hypothesis 1

In the light of hypothesis 1, stated in section 4.2.1, the following null hypothesis was tested.

There is no significant difference between the average achievements of a group of learners exposed to technology during a lesson compared to the group not exposed to technology.

In order to test the null hypothesis, two groups of learners were exposed to lessons in three different learning areas. Group 1 (the experimental group) was exposed to technology during each of the lessons, while Group 2 (the control group) was taught the identical lessons but not exposed to any form of technology during the lessons.

The stated null hypothesis was tested independently for each of the learning areas. In order to test the null hypothesis, it was necessary to calculate the mean, the standard deviation and the t-values for each of the achievement tests obtained after teaching the Geography, Mathematics and English lessons. The t-test was calculated as to ascertain

whether a significant difference exists between the averages of the content sections of the three lessons given to the two groups. The data has been tabulated in table 5.4.

TABLE 5.4

STATISTICAL DATA FOR THE CONTENT SECTION OF THE ACHIEVEMENT TESTS

1 = experimental group 2 = control group

			\bar{X}	S	t value	P
GEOGRAPHY CONTENT	1	23	7.52	0.99	3.85	p < 0.01
	2	22	5.5	2.26		
MATHEMATICS CONTENT	1	23	6.87	1.49	5.13	p < 0.01
	2	22	4.32	1.84		
ENGLISH CONTENT	1	23	9.39	0.72	7.61	p < 0.01
	2	22	6.32	1.76		

DF = 43

According to the t-values in table 5.4, the null hypothesis can be rejected on the 1% level of significance for all three learning areas. There is a significant difference between the average achievements of a group of learners exposed to technology during a lesson compared to a group not exposed to technology. This applies to each of the three learning areas. It seems that technology plays a significant role in the achievement of learners in Geography, Mathematics and English.

The results of this research support the findings of Felder and Soloman (2001), John and Wheeler (2008:48), Smaldino et al. (2008: 259) as well as Khine and Fisher (2003:37) (refer to paragraph 2.3 and 2.3.1). These studies emphasise that learners would retain more information with the help of sufficient stimulating technological content in their learning materials, the potential achievement when making use of multimodalities, that students today are visual learners having been brought up with

technology, show the achievement of results when making use of the interactive whiteboards in the classroom and state that in technology-rich learning environments, students can explore new information, construct new knowledge and link theories into practice thus maximising their achievement.

A study conducted by Bitter and Legacy (2008: 152) (referred to in section 2.3), shows that students have higher comprehension scores after reading electronic stories versus printed texts of the same stories. This study is confirmed (in section 1.1) by O'Donnell et al. (2006: 3) who found that higher levels of learning goals can be accomplished if supported by various technological applications.

In conclusion, Khine and Fisher (2003: 22) (refer section 3.1) found that educators must seriously consider matching the appropriate use of technology with content to maximise the student's potential in learning, corroborating the results in this study.

5.4.2 Hypothesis 2

In the light of hypothesis 2, stated in section 4.2.2, the following null hypothesis was tested.

There is no significant difference between the average attentions of a group exposed to technology during the lesson compared to a group not exposed to technology.

In order to test the null hypothesis, two groups of learners were exposed to lessons in three different learning areas. Group 1 (the experimental group) was exposed to

technology during each of the lessons, while Group 2 (the control group) was taught the identical lessons but not exposed to any form of technology during the lessons.

The stated null hypothesis was tested independently for each of the learning areas. In order to test the null hypothesis, it was necessary to calculate the mean, the standard deviation and the t-values for each of the attention tests obtained after teaching the Geography, Mathematics and English lessons. The t-test was calculated so as to ascertain whether a significant difference exists between the averages of the attention sections of the three lessons in the experimental and control groups. The data has been tabulated in table 5.5.

TABLE 5.5
STATISTICAL DATA FOR ATTENTION SECTION OF THE ACHIEVEMENT TESTS

		1 = experimental group 2 = control group		\bar{X}	S	t value	p
GEOGRAPHY ATTENTION	1	23	8.9	1.08	6.59	p < 0.01	
	2	22	6.18	1.65			
MATHEMATICS ATTENTION	1	23	7.13	1.46	4.28	p < 0.01	
	2	22	5.28	1.45			
ENGLISH ATTENTION	1	23	8.87	1.25	4.46	p < 0.01	
	2	22	6.41	2.28			

DF = 43

According to the t-values in table 5.5, the null hypothesis can be rejected on the 1% level of significance for all three learning areas. There is a significant difference between the average attentions of a group of learners exposed to technology during a lesson compared to a group not exposed to technology. This applies to each of the

three learning areas. It seems that technology plays a significant role in the attention of learners in Geography, Mathematics and English.

The results of this research support the findings noted in the literature study (refer to sections 1.1, 2.2.1, 3.3). Shelley (2004: 6.11); Parker (2008: 281) and Bitter and Legacy (2008: 287) stated that in today's world, teachers have found that using computers or computer-related technologies can capture and hold students' attention. It was also found that electronic technologies may stimulate a learner's interest and give them control over their learning and that young technology fanatics expect teachers to offer learning opportunities in engaging formats.

By making use of technology in the classroom, the educator finds he/she is speaking the familiar language of the learners. This ensures attention is optimised while learning takes place. The findings in this study confer with these thoughts and accept that the presence of technology in the classroom maximises the attention of the learners.

5.4.3 Hypothesis 3

In the light of hypothesis 3 stated in section 4.2.3, the following null hypothesis was tested.

There is no significant relationship between the motivation of learners and their achievement.

In order to test the null hypothesis, it was necessary to calculate the correlation coefficient between motivation and achievement. The results have been tabulated in table 5.6.

TABLE 5.6
CORRELATION COEFFICIENT BETWEEN MOTIVATION AND ACHIEVEMENT

N = 45	ACHIEVEMENT GEOGRAPHY	ACHIEVEMENT MATHEMATICS	ACHIEVEMENT ENGLISH
MOTIVATION	0.18	0.24	0.15

p > 0.05 in all three instances

The null hypothesis cannot be rejected in any of the three learning areas. The correlation between motivation and achievement in Geography (0.18), achievement in Mathematics (0.24) and achievement in English (0.15) was found to be very low and insignificant. This is most probably due to the fact that the study was conducted on a micro level. If motivation was correlated with achievement in a number of lessons in each learning area, higher and significant correlations may have been obtained.

The findings in this study contradict the findings of Willougby and Wood (2008: 11) who stated that the presence of technologies in both formal and informal contexts makes them a particularly salient and motivating learning tool. Barr and Parrett (2008: 336) agree with this, (refer section 1.5.2), and found that the more motivated a learner is, the more they engage in learning. Lytras et al. (2008: 189) (refer to section 1.6.1), also found that a learner's motivation is connected to the learner's engagement with the learning material.

In conclusion, Sigman (2007: 162), (refer section 2.2.1), emphasised that man's achievement is based on the extent to which he is motivated in the environment. It is therefore probable that if this study was based on a macro-level, the findings tested in this hypothesis could possibly elicit differing results.

5.4.4 Hypothesis 4

In the light of hypothesis 4, stated in section 4.2.4, the following null hypothesis was tested.

There is no significant relationship between the motivation and concentration of learners.

In order to test the null hypothesis, it was necessary to calculate the correlation coefficient between motivation and concentration. The result is tabulated in table 5.7 below:

TABLE 5.7
CORRELATION COEFFICIENT BETWEEN MOTIVATION AND CONCENTRATION

N = 45	CONCENTRATION
MOTIVATION	0.711

$p < 0.01$

Table 5.7 shows that the null hypothesis can be rejected at the 1% level of significance. A high positive relationship exists between motivation and concentration ($r = 0.71$; $p < 0.01$).

These results are confirmed in Treisman and Souther's (1986: 14) (refer to section 2.2.1) attenuation model which accentuates when a learner is motivated in a lesson that he is able to concentrate for sustained periods of time. Neisser (1976: 215) (refer to section 2.2.3) agrees with this in his stimulus-properties theory where he proposes that motivating stimuli play a key role in optimizing concentration.

5.4.5 Hypothesis 5

In the light of hypothesis 5, stated in section 4.2.5, the following null hypothesis was tested.

There is no significant relationship between the motivation of learners and their attention during a lesson.

In order to test the null hypothesis, it was necessary to calculate the correlation coefficient between motivation and attention. The results have been tabulated in table 5.8.

TABLE 5.8
CORRELATION COEFFICIENT BETWEEN MOTIVATION AND ATTENTION

N = 45	ATTENTION GEOGRAPHY	ATTENTION MATHEMATICS	ATTENTION ENGLISH
MOTIVATION	0.22	0.30 *	-0.01

* $p < 0.05$. For the other two coefficients, $p > 0.05$

The data in table 5.8 indicates that the null hypothesis can be rejected on a 5% level of significance for Mathematics while the null hypothesis cannot be rejected for Geography and English. This is most probably due to the fact that the study was conducted on a micro level. If motivation was correlated with attention in a number of lessons in each learning area, higher and significant correlations may have been obtained.

Treisman's (1980) information processing and selection theory based on Neisser's (1976) theory confirms the results obtained for the Mathematics but it contradicts the results obtained for Geography and English. Treisman found that a learner pays attention according to how motivated he/ she is at the time. Ashley (2005: 10) (refer to section 1.6.1) also agrees with the findings from the Mathematics data and points out that it is not the fact that children cannot pay attention, but that today's children have great difficulty sustaining attention unless sufficiently motivated to do so. The more motivated a learner is, the more likely he/she is to sustain the attention. This is confirmed by Willis (2005: 32) (refer to section 1.6.2) who states that information must motivate a learner sufficiently otherwise attention is withdrawn.

If a teacher can stimulate a student's thirst for learning by making use of the student's life-world to capture attention and therefore motivate the student to learn, the student is likely to pursue learning on his/her own (Barr & Parrett, 2008: 196).

5.4.6 Hypothesis 6

In the light of hypothesis 6, stated in section 4.2.6, the following null hypothesis was tested.

There is no significant relationship between the concentration of learners and their achievement.

In order to test the null hypothesis, correlation coefficients have been calculated between the concentration of the learners and their achievement in the three learning areas. The results have been tabulated in table 5.9.

TABLE 5.9
CORRELATION COEFFICIENT BETWEEN CONCENTRATION AND ACHIEVEMENT

N = 45	ACHIEVEMENT	ACHIEVEMENT	ACHIEVEMENT
	GEOGRAPHY	MATHEMATICS	ENGLISH
CONCENTRATION	0.09	- 0.04	- 0.12

p > 0.05 in all instances

The null hypothesis cannot be rejected in any of the three learning areas. The correlation between concentration and achievement in Geography (0.09), achievement in Mathematics (-0.04) and achievement in English (-0.12) was found to be insignificant. This is probably due to the fact that the study was conducted on a micro-level. If the study was repeated using more lessons in each learning area, the chances are that the results may differ.

The findings in this hypothesis do not support the findings noted in the literature study (refer to sections 2.2.1 and 2.2.3). O’Flynn et al. (2003: 109); Fisher and Khine (2006: 205) and Broadbent (1958) reported that when a learner knows he could achieve, he is more likely to concentrate. Commitment to achieving in the current task is vital in maintaining concentration and that one would concentrate over a sustained period of time if new knowledge could be linked to what has previously been achieved.

5.4.7 Hypothesis 7

In the light of hypothesis 7, stated in section 4.2.7, the following null hypothesis was tested.

There is no significant relationship between the concentration of learners and their attention.

In order to test the null hypothesis, the correlation coefficient has been calculated between the concentration of the learners and their attention in the three learning areas. The correlation of each learning area has been individually calculated and tabulated below in table 5.10.

TABLE 5.10
CORRELATION COEFFICIENT BETWEEN CONCENTRATION AND ATTENTION

N = 45	ATTENTION GEOGRAPHY	ATTENTION MATHEMATICS	ATTENTION ENGLISH
CONCENTRATION	- 0.01	0.04	- 0.28

p > 0.05 in all instances

The data in table 5.10 indicates that the correlation between concentration and attention is low and insignificant in all three learning areas. The null hypothesis can therefore not be rejected. This is most probably due to the fact that the study was conducted on a micro level. If concentration was correlated with attention in a number of lessons in each learning area, higher and significant correlations may have been obtained.

The literature review (sections 1.4, 1.7, 2.2.4) does not support the results found in the testing of this hypothesis. Rapaport (1945: 168); Wubbels and Levy (1993: 57); Wubbels and Brekelmans (1997: 84); Riah and Fraser (1998:1); Chionh and Fraser (1998: 2); Margianti et al. (2001: 3); Waxman and Padron (2002: 5) show a definite link between the attention which a learner is able to elicit and the concentration which they can maintain in a lesson, where attention is regarded as automatic and effortless whereas concentration is voluntary and effortful.

5.5 CONCLUSION

The interpretation and analysis of the results obtained from the questionnaires as well as the results obtained from the tests administered after the lessons were discussed in this chapter. The item analysis and reliability coefficients for the two constructs, motivation and concentration, were obtained. The hypotheses were tested and the results obtained were analysed in conjunction with the literature review.

The findings indicated that there is a significant difference between the average achievements of a group of learners exposed to technology during a lesson compared to a group not exposed to technology; there is a significant difference between the

average attentions of a group of learners exposed to technology during a lesson compared to a group not exposed to technology; there is a significant relationship that exists between motivation and concentration; that no significant relationship exists between motivation and achievement; motivation and attention (in Geography and English); concentration and achievement; concentration and attention, in this particular study which was done on a micro level; and that a significant relationship exists between motivation and attention in Mathematics.

6. SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

6.1 INTRODUCTION

Chapter six aims to provide a broad overview of the entire study and on the basis of this, recommendations have been made to educationalists in addressing the effects of technology on concentration and attention in the classroom.

This study endeavoured to find answers to the following problem:

- Is the lack of technology in the classroom a contributing factor to the problem of attention and concentration in the classrooms of today?

6.2 LITERATURE REVIEW

A learner's capacity for attention leading to their ability to concentrate depends on factors which include commitment and enthusiasm for the task, skills at doing the task, emotional and physical state, psychological state, and the learner's educational and home environments. Taking these factors into account during lessons, the teacher needs to ensure that the learner is motivated to attend to the lessons. Learners of today spend many hours making use of technology. This needs to be kept in mind while preparing lessons in order to ensure that the learner's attention is captured and maintained in order for sufficient learning to take place.

Schools are a reflection of the social, economic and political communities in which they exist. The more schools expand their curricula and instruction outside the school walls, the more students become engaged in learning, the more relevance they see in learning, and the more motivated they become (Barr & Parrett, 2008: 336). Today's students are the first generation that has grown up in a digital world. The challenge for the schools of today is to create educational environments that expand and enhance the ability of these "digital natives" while empowering them with knowledge and skills needed for success in a global society. These changes will impact tomorrow's technology used by teachers and students, the structure of classrooms and the role of teachers (Smaldino et al. 2008: 344).

It is however important to note that students do not learn from the technology, but that technologies can support meaning making by students (Khine & Fisher, 2003: 37). Teachers need to remember that they are preparing to teach in the 21st century and they need to become accustomed to 21st century technology. For children who have been turned off by more traditional school activities, electronic technologies may stimulate their interest in learning by adding a fun factor, while at the same time giving them some form of control over what and how they learn.

Teachers are keys for assessing educational reform that adequately prepares students to meet the challenges of the current technological era. Learners of today are captivated by technology and they pay attention when technology is used. Teachers are able to maintain their concentration for significant periods of time when using technology in lessons.

6.3 FINDINGS FROM THE EMPIRICAL INVESTIGATION

The empirical research endeavoured to investigate the main research problem namely:

- Is the lack of technology in the classroom a contributing factor to the problem of attention and concentration in the classrooms of today?

The data was collected by means of three lessons conducted in a classroom to a control group and to an experimental group. The learners were in grade eight classes. The control group's lessons were presented without any form of technology while the experimental group were presented with the identical lessons however these were presented by making use of technology. A test was administered at the end of each of the three lessons consisting of twenty questions. Ten of these questions were directly related to content while the other ten were attention based questions, related to the lessons. The learners also completed a questionnaire consisting of forty items which contained motivation and attention statements.

In the empirical investigation of this study, a number of central findings were made. The final results indicated that:

- There is a significant difference between the average achievements of a group of learners exposed to technology during a lesson compared to a group not exposed to technology.
- There is a significant difference between the average attentions of a group of learners exposed to technology during a lesson compared to a group not exposed to technology.

- A significant relationship exists between motivation and concentration.
- No significant relationship exists between motivation and achievement; motivation and attention (in Geography and English); concentration and achievement; concentration and attention, in this particular study which was done on a micro level.
- A significant relationship exists between motivation and attention in Mathematics.

6.4 LIMITATIONS

A limitation of the investigation was that the study was conducted amongst a small sample of a particular socio-economic group at an independent school in a specific geographical area within South Africa. Another limitation of the study was the limited lessons conducted for the study. These factors limit the ability to generalise the research findings.

The questionnaires can be viewed as intrusive as the participants often seem tentative to answer every item in case the questionnaire lands in the wrong hands. The researcher cannot ascertain if their awareness of completing the questions affected their participation and indirectly their answers. The participants were assured of anonymity.

It is a reality that only a limited number of survey data can be collected and that the findings therefore cannot and should not be taken as either exhaustive or conclusive.

There is a great deal of room for additional research in this area in South African classrooms. The researcher is under no illusions that this research is absolute.

6.5 RECOMMENDATIONS FOR FUTURE RESEARCH

This study has aimed to achieve its intended objectives; however it has also opened up a number of areas and avenues for further research which are identified below:

- A provincial or national survey regarding the effects of technology on the attention and concentration within the classroom context.
- A study of the use of technology by learners in the home which may affect their attention and concentration.
- A study on the number of teachers who use technology in the classroom and who have adapted lessons to include a more digital approach to teaching.
- A study on the preferred methods of teaching from a learner's point of view as well as a teacher's point of view.
- An investigation into the role of attention and concentration in the classroom.

6.6 FINAL CONCLUSION

The effects of technology on the attention and concentration of learners in the classroom, has been a very interesting topic to research. A study of the literature review and theories related to attention and concentration has identified numerous characteristics of the topic which indicate how the topic has evolved.

Learners of today are exposed to technology from a very young age and are mostly proficient in the use of this technology. This captures their attention and maintains their concentration for a sustained period of time. However, not many teachers incorporate the use of technology in their lessons in the classroom. The learners are expected to sit still and to be captivated by lessons that involve very little of their proficient language.

Technology has such potential for education and teachers and while it will never replace the human aspect of teaching, it should and can be utilised very successfully in the classroom in order to attract the attention of the learners and to maintain their concentration. This could have a favourable effect on the learner's achievement in the classroom.

The investigation has aimed to provide beneficial insights and guidelines into a fairly new educational issue. In light of this, it is hoped that this study will serve as a valuable contribution to better understand the concepts of attention and concentration as well as the role and implications of technology in the classroom.

The findings of the foregoing literature study and empirical investigation have provided a basis from which the following recommendations are proposed to educationalists, principals and educational psychologists:

- Encourage the use of technology in the classroom as it is the language understood by the learners of today.

- Teachers should be flexible in the presentation of their lessons and learning material in order to capture the attention of learners and to maintain the concentration throughout the lesson.
- Learners are familiar with the fast moving, dynamic digital world and should not have to power down when they come to school.

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8. APPENDICES

8.1 APPENDIX A: TIMELINE OF ATTENTION THEORIES

Pre-1880s: Franciscus Donders uses mental chronometry (the study of the temporal sequencing of information processing in the brain) to study attention with reaction time experiments. Wundt develops a research program to justify experimental psychology as a separate discipline; he uses introspection as a method of gathering information into psychological processes.

1880s-1890s: At the Leipzig institute, using well-defined, quantitative, and easily reproducible experimental methodology, Wundt conducts studies on: sensation and perception, reaction times, attention and feeling, and association.

1894: Helmholtz defines what is now known as 'covert attention' during a visual perception task. Scientific study of covert attention did not re-surface until the 1950s.

1900-mid 1950s: Due to the popularity of behaviourism in psychology (emphasizing the association between a stimulus and a response, but without identifying the cognitive operations that lead to that response), research on attention is neglected.

1924: Electroencephalography (EEG) is invented, which will become important in later neurological studies of attention.

1935: John Ridley Stroop, in his article entitled Studies of Interference in serial verbal reactions, discovers the Stroop effect (slower reaction times and an increase in

mistakes when a word is printed in a colour differing from the colour expressed by the word's semantic meaning).

1946: Magnetic Resonance Imaging (MRI) is invented, which will become important in later neurological studies of attention.

1950s: Research psychologists (including Donald Broadbent) renew their interest in attention in a shift from positivism to realism in psychology, deemed as the cognitive revolution (admitted that unobservable cognitive processes can be studied scientifically).

1952: Broadbent begins to publish his research findings from dichotic listening experiments on speaking and listening simultaneously, listening to synchronous messages, and failures of attention in selective listening.

1953: Colin Cherry first describes the Cocktail Party Effect (the ability to focus our listening attention on a single talker among a mixture of conversations and background noises, and to pay attention to a stimulus that grabs our attention suddenly, such as our names).

1957: Broadbent develops his mechanical model of attention.

1958: Broadbent becomes clinical director of the Applied Psychology Unit at Cambridge. His book, Perception and Communication, is published, which describes his filter model of attention (an early selection model). This model was highly influential but was criticized for being too "inflexible".

1960s: Advent of information processing as the dominant perspective in cognitive psychology. Stroop's work was rediscovered. John Ridley Stroop was the man who tried to prove a person's concentration by confusing the brain. This effect, now known as the Stroop effect, was first reported in the classic article "Studies of Interference in Serial Verbal Reactions" published in the Journal of Experimental Psychology in 1935. Since then, this phenomenon has become one of the most well known in the history of psychology.

1964: Use of Stroop Colour-Word task as a measure of attentional and linguistic processes rose quickly

1969: Treisman proposed her Attenuation Theory, which addresses how unattended information may get through to consciousness (not explained by Broadbent's original model).

1971: Broadbent's second book on the topic of attention, Decision and Stress, is published, using his filter model as a starting point in his new theory, and taking into account findings from Cherry, Treisman and others.

1975: Broadbent wins a Distinguished Scientific Contribution award from the APA for being the first person to systematically study humans as an information-processing system and using a structure that could be investigated by experiment.

1980: Treisman and Gelade publish their seminal paper which was the basis for Treisman's Feature Integration Theory.

1988: Treisman interprets the pop-out effect as evidence for a pre-attentive mechanism in perception. (Pre-attentive processes are based on perceptual analyses that simply signals the presence of a difference in the visual scene, rather than on the action of focused attention.)

1993: Following Broadbent's death, numerous tributes and obituaries are published in his honour, and to recognize that his elaboration of the idea of the human organism as an information-processing system lead to a systematic study of attention.

http://en.wikibooks.org/wiki/Applied_History_of_Psychology/History_of_Research_on_Attention

8.2 APPENDIX B: MEASURING INSTRUMENT

**PERSONAL QUESTIONNAIRE
FOR
SECONDARY SCHOOL LEARNERS**

PLEASE READ THE FOLLOWING INSTRUCTIONS CAREFULLY

- a. The questionnaire that you are going to answer, concerns you as a learner. It is not a test, but merely an information exercise. There are no correct or incorrect answers.
- b. Please answer the questions honestly and not according to how you think others would expect you to answer.
- c. Your answers will be treated as confidential.

NAME:.....

SECTION A

Provide the following information by writing the applicable number in the block provided:

1. Learner number

c1	c2

2. Gender (male = 1; female = 2)

c3

3. Home language

(English = 1; Afrikaans = 2; African language = 3; Other = 4)

c4

SECTION B

INSTRUCTIONS

Read each statement carefully. Decide how you feel about the statement by choosing a number from 1 to 6 according to the scale below:

I disagree completely 1 2 3 4 5 6 I agree completely

Remember it is what **you** think and not how others judge you!

1. I am always motivated to go to class
c5
2. I am easily distracted in class
c6
3. My work receives my undivided attention in class
c7
4. If a task is difficult, I give up easily
c8
5. I always come up with reasons not to do my homework
c9
6. It bothers me if I neglect my studies
c10

I disagree completely

1 2 3 4 5 6

I agree completely

7. I find it difficult to sit still in class

c11

8. Where homework is concerned I put duty before pleasure

c12

9. I can pay attention for the whole period

c13

10. I can stay focussed on what is going on in the class

c14

11. The teacher often reminds me to be attentive during the lesson

c15

12. I hate going to certain classes

c16

13. I do my homework when I feel like it

c17

14. I find it difficult to concentrate during a lesson

c18

I disagree completely

1 2 3 4 5 6

I agree completely

15. I fidget a lot in class

c19

16. I set achievement goals in my schoolwork and try to reach them

c20

17. I often need to move around in class

c21

18. If a task is too difficult, I do not even try it

c22

19. I am usually enthusiastic at the beginning of an assignment but
after a while my enthusiasm fades

c23

20. I catch myself daydreaming during class

c24

21. I concentrate on the task I am busy with during class

c25

22. It bothers me if I haven't done my homework on a particular day

c26

I disagree completely

1 2 3 4 5 6

I agree completely

23. I make mistakes because I don't pay attention in class to the teachers instructions

c27

24. As far as homework is concerned I spend my time productively

c28

25. I love to learn new work and extend my knowledge

c29

26. I ignore distractions during class

c30

27. I get lost in my own thoughts during lessons

c31

28. As far as schoolwork is concerned, I regard myself as a hard worker

c32

29. I am determined to pass with high marks

c33

30. I can concentrate on the topic being taught during a lesson

c34

31. I do not need to be told to do my homework

c35

I disagree completely

1 2 3 4 5 6

I agree completely

32. I often think of other things during a lesson

c36

33. I catch up on schoolwork that I have missed

c37

34. I am motivated to learn difficult, challenging tasks

c38

35. I often miss out on what the teacher says

c39

36. I often turn off when the teacher speaks

c40

37. I constantly postpone doing my homework

c41

38. I only pay attention when the lessons are interesting

c42

39. I find the teacher's voice monotonous

c43

40. As far as schoolwork is concerned, I do what I am supposed to do

c44

FOR OFFICE USE ONLY:

i. Learning Area (English = 1; Maths = 2; Geography = 3)

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c45

ii. Group (Experimental = 1; Control = 2)

--

c46

iii. Content Achieved (Total 10)

--	--

c47 c48

iv. Attention Achieved (Total 10)

--	--

c49 c50

v. Learning Area (English = 1; Maths = 2; Geography = 3)

--

c51

vi. Group (Experimental = 1; Control = 2)

--

c52

vii. Content Achieved (Total 10)

--	--

c53 c54

viii. Attention Achieved (Total 10)

--	--

c55 c56

ix. Learning Area (English = 1; Maths = 2; Geography = 3)

--

c57

8.3 APPENDIX C: GEOGRAPHY LESSON PLAN – CUCHI TUNNELS

GEOGRAPHY LESSON PLAN	
Grade	8
Theme	Vietnam
Assessment standard	<p>LO 1: Geographical Enquiry <i>The learner will be able to use enquiry skills to investigate geographical and environmental concepts and processes.</i></p> <p>LO 2: Knowledge and Understanding <i>The learner will be able to demonstrate geographical and environmental knowledge and understanding.</i></p> <p>LO 3: Exploring Issues <i>The learner will be able to make informed decisions about social and environmental issues and problems.</i></p>
Planned date	22/07/2009
Actual date	22/07/2009
Duration	40 minutes
Introduction	Teacher introduces the lessons by asking class what they know and understand about Vietnam.
Lesson development	The ppt is then shown to the experimental class while the same basic Vietnamese information is shared with both classes.
Activity (experimental group)	<p>Power point presentation shown on visualiser, outlining:</p> <ul style="list-style-type: none"> • Vietnamese landscape • Historical perspective • Cuchi tunnels • Ho-Chi Ming City • Countryside • People • Food, money and basic culture

Activity (control group)	Information shared with the class, outlining: <ul style="list-style-type: none"> • Vietnamese landscape • Historical perspective • Cuchi tunnels • Ho-Chi Ming City • Countryside • People • Food, money and basic culture
Knowledge, skills, values	<p>Important enquiry processes include:</p> <ul style="list-style-type: none"> • asking questions, finding information, and organising, analysing and synthesising information; • answering questions and considering practical actions where possible; and • reporting on the finding of the enquiry process using different communication skills. <ul style="list-style-type: none"> • people and places; • people and resources; and • people and the environment. <ul style="list-style-type: none"> • identifying the issue; • understanding factors affecting the issue; and • making choices or decisions or providing alternatives.
Assessment	A twenty mark test is issued after 30 minutes of the lesson; subdivided into 10 marks for content and 10 marks for attention
Resources	en.wikipedia.org/wiki/Vietnam_War www.lonelyplanet.com/vietnam www.vietnamtourism.com www.geographia.com/vietnam

8.4 APPENDIX D: MATHEMATICS LESSON PLAN – MOBIUS STRIP

MATHEMATICS LESSON PLAN	
Grade	8
Theme	Geometry - Mobius strip
Assessment standard	Learning Outcome 3: Space and Shape (Geometry) <i>The learner will be able to describe and represent characteristics and relationships between two-dimensional shapes and three-dimensional objects in a variety of orientations and positions.</i>
Planned date	24/07/2009
Actual date	24/07/2009
Duration	40 minutes
Introduction	The teacher shows the class a 3-D mobius strip made from cardboard and asks for suggestions for its possible uses.
Activity (experimental group)	A video clip of the Mobius strip is shown to the experimental group showing a step-by-step process of how to make a strip.
Activity (control group)	The teacher shows the class the step-by-step process of how to make a strip.

<p>Knowledge, skills, values</p>	<p>The study of space and shape improves understanding and appreciation of the pattern, precision, achievement and beauty in natural and cultural forms. It focuses on the properties, relationships, orientations, positions and transformations of two-dimensional shapes and three-dimensional objects.</p> <p>The study of space and shape enables the learner to:</p> <ul style="list-style-type: none"> • develop the ability to visualise, interpret, calculate relevant values, reason and justify; and • interpret, understand, classify, appreciate and describe the world through two-dimensional shapes and three-dimensional objects, their location, movement and relationships. <p>The learner should gain these skills from experiences with concrete objects, through drawing and construction, and in the abstract justification of spatial relationships. It is important that the study of two-dimensional shapes and three-dimensional objects be contextualized.</p>
<p>Assessment</p>	<p>A twenty mark test is issued after 30 minutes of the lesson; subdivided into 10 marks for content and 10 marks for attention.</p>
<p>Resources</p>	<p>en.wikipedia.org/wiki/Möbius_strip www.youtube.com scidiv.bellevuecollege.edu/math/Mobius.html www.cut-the-knot.org/do_you_know/moebius.shtml</p>

8.5 APPENDIX E: ENGLISH LESSON PLAN – POEM

ENGLISH LESSON PLAN	
Grade	8
Theme	Poem – How to Torture your Teacher
Assessment standard	<p>Learning Outcome 1: Listening <i>The learner will be able to listen for information and enjoyment, and respond appropriately and critically in a wide range of situations</i></p> <p>Learning Outcome 2: Speaking <i>The learner will be able to communicate confidently and effectively in spoken language in a wide range of situations.</i></p> <p>Learning Outcome 5: Thinking and Reasoning <i>The learner will be able to use language to think and reason, as well as to access, process and use information for learning.</i></p> <p>Learning Outcome 6: Language Structure and Use <i>The learner will know and be able to use the sounds, words and grammar of the language to create and interpret texts.</i></p>
Planned date	23/07/2009
Actual date	23/07/2009
Duration	40 minutes
Introduction	Learners are asked to close their eyes and think about ways they have annoyed their teachers.
Lesson development	The teacher reads the poem “How to Torture your Teacher” by Bruce Lansky.
Activity (experimental group)	The poem is heard on an auditory tape and simultaneously, pictures depicting the poem are viewed on the interactive SMART board. A short discussion ensues after the presentation of the poem.
Activity (control group)	The teacher reads the poem to the class. A short discussion ensues after the presentation of the poem.

Knowledge, skills, values	<p>Learners will listen actively, empathetically and critically to a wide range of oral texts, and summarise, record and respond to them.</p> <p>Learners will speak confidently in public, and communicate appropriately and effectively with others. This is necessary for work and further education.</p> <p>More developed thinking skills and information literacy are the gateway to lifelong learning and achievement of the Critical and Developmental Outcomes.</p> <p>Learners will explore how language works, and develop a shared language for talking about language (a 'meta-language'), so that they can evaluate their own and other texts critically in terms of meaning, effectiveness and accuracy. They will become aware of how language changes over time and between cultures, and how it changes in different situations.</p>
Assessment	<p>A twenty mark test is issued after 30 minutes of the lesson; subdivided into 10 marks for content and 10 marks for attention</p>
Resources	<p>www.poetryteachers.com/.../howtotortureteacher.html</p> <p>www.gigglepoetry.com/poetrytheaterdetail</p>