



Secondary School Students' Perceptions of eContent Design: An Activity Theory Perspective

By

Kinsley Ndenge

NDNKIN001

A minor dissertation submitted in partial fulfillment of the requirements for the
award of the degree of Master in Education (ICTs)

Faculty of the Humanities

University of Cape Town

2016

Supervisor: Associate Professor Dick Ng'ambi

The copyright of this thesis vests in the author. No quotation from it or information derived from it is to be published without full acknowledgement of the source. The thesis is to be used for private study or non-commercial research purposes only.

Published by the University of Cape Town (UCT) in terms of the non-exclusive license granted to UCT by the author.

Declaration

I declare that the dissertation hereby submitted by me for the MAGISTER EDUCATIONIS degree at the University of Cape Town is my own independent work and has not previously been submitted by me at another university or faculty. All the sources I have used or quoted have been indicated and acknowledged by means of complete references. I further cede copyright of this thesis in favor of the University of Cape Town

.....

Kinsley Ndenge

6/14/2017

.....

DATE

Acknowledgements

I would like to sincerely thank the following people and institutions for contributing to the success of this study in one way or another. This would not have been a success without the valuable contribution from the following:

- My supervisor, Prof. Dick Ng'ambi, and lecturers, Prof. Cheryl Hodgkinson-Williams and Dr. Cheryl Brown, who assisted me throughout the course and always provided me with constructive feedback.
- The Florida Virtual School for providing me with access to their learning management system and permitting me to carry out this study.
- Research participants who were interviewed.
- The Mellon Scholarship offered through the University of Cape Town. The financial support was really helpful.
- My colleagues and friends, Gabriel Konayuma, Khanyisile Ngondwana, for their support.
- The editors, Elizabeth le Sueur, Rob Ettershank and Liz Biggs for reading through and editing this report.
- My parents, Edward and Pauline Ndenge, for their continuous love and support.

Acronyms

AT	Activity Theory
CHAT	Cultural Historic Activity Theory
eContent	Electronic Content
FLVS	Florida Virtual School
GCE	General Certificate of Education
ICT	Information Communications Technology
IEEE	Institute of Electrical and Electronic Engineering
ID	Instructional Design
ISD	Instructional Systems Design
MEd	Master in Education
MOOC	Massive Online Open Courses
LMS	Learning Management System
LO	Learning Objects
LORI	Learning Object Review Instrument
OER	Open Educational Resources
PhD	Doctor of Philosophy
TG	Text Genre
TAM	Technology Acceptance Model

ABSTRACT

This research investigates how Secondary School science learners in Cameroon perceive the design of electronic content (eContent). Perception plays an important role in how learners use eContent; hence the perception of how eContent is designed could affect how learners learn using this digital content. Online learning and the use of digital learning materials has emerged as a hallmark of the information age to connect and engage users in the learning process. Learners are moving from the use of paper to the use of digital channels for learning, therefore perception of design becomes very important. Without good perception of how learning material is designed, the teaching process would be an uphill task and this could greatly hinder the academic performance of learners, leading to high failure rates. Apart from how learning material is designed, perception is also a product of the socio-cultural environments hence how learners perceive eContent, might be affected by the setting within which it is designed.

In this study, a group of Cameroonian learners' use of eContent that was designed in a social- cultural context different from their own is studied. The primary research question is aimed at investigating how the learners' perception of eContent affects its use. The researcher uses Cultural Historical activity theory (CHAT) as a theoretical framework to understand how students perceive the activity mediated by eContent. By identifying the factors in an activity system that affect learners' perception using activity theory, specific recommendations will be made to educators on what to change in the system to foster positive perceptions hence achieve meaningful learning mediated by eContent.

Table of Contents

DECLARATION	I
ACKNOWLEDGEMENTS.....	II
ACRONYMS	III
ABSTRACT	IV
CHAPTER 1: INTRODUCTION	6
1.1 OVERVIEW	6
1.2 RATIONALE OF STUDY.....	6
1.3 THE CAMEROON CONTEXT	7
1.4 BACKGROUND OF STUDY	8
1.5 RESEARCH QUESTIONS	10
1.6 RESEARCH AIM AND OBJECTIVES	11
1.7 RESEARCH METHODOLOGY.....	13
1.8 SIGNIFICANCE OF STUDY.....	13
1.9 DISSERTATION OUTLINE.....	14
1.10 CHAPTER SUMMARY	15
CHAPTER 2: LITERATURE REVIEW AND THEORETICAL FRAMEWORK	16
2.1 INTRODUCTION	16
2.2 CONCEPTUALIZATION OF ECONTENT.....	16
2.2.1 PERCEPTION OF ECONTENT	17

2.2.2 HOW PERCEPTION AFFECTS USE	20
2.4.3 PERCEPTION OF ECONTENT DESIGN:	22
2.5 EMERGING TECHNOLOGIES AND USE OF SOCIAL MEDIA IN DESIGN	24
2.6 DESIGNING ECONTENT TO IMPROVE PERCEPTION AND USE	26
2.6.1 UNDERSTANDING CONTRADICTIONS IN CHAT AND HOW IT AFFECTS PERCEPTION.....	28
2.7 UNDERSTANDING ACTIVITY THEORY IN RELATION TO THIS STUDY	30
2.7.1 JUSTIFICATION OF AT AS THEORETICAL FRAMEWORK FOR THIS STUDY.....	33
2.8 RELATED STUDIES ON PERCEPTION OF LEARNING WITH ECONTENT.....	38
2.9 CONCEPTUAL FRAMEWORK.....	41
2.10 SUMMARY OF CHAPTER.....	44
CHAPTER 3: RESEARCH METHODOLOGY.....	45
3.1 INTRODUCTION	45
3.2 RESEARCH DESIGN	46
3.3RESEARCH PARTICIPANTS	47
3.4 PROCEDURE USED TO CARRY OUT STUDY	48
3.5INTERVIEW METHODS	51
3.5.1 INTERVIEWING AND INTERVIEW GUIDES (APPENDIX 1)	52
3.6VALIDITY AND ETHICAL ISSUES.....	54
3.6.1 PILOT TESTING OF INSTRUMENTS	54
3.6.2 RESEARCH ETHICS:.....	54

3.6.3 RESEARCHERS BIAS:	55
3.6.4 REACTIVITY.....	56
3.7SUMMARY OF CHAPTER.....	56
CHAPTER 4: ANALYSIS OF RESULTS	57
4.1 INTRODUCTION	57
4.2CODING OF DATA	57
4.2 RESEARCH PROCEDURE.....	58
4.3 DATA PRESENTATION: SEE APPENDIX 5.....	60
4.4ANALYTICAL FRAMEWORK.....	60
4.7DISCUSSIONS.....	68
4.8 SUMMARY OF CHAPTER	71
CHAPTER 5: CONCLUSION & RECOMMENDATION	72
5.1INTRODUCTION	72
5.2 REVIEW OF PURPOSE OF THE STUDY.....	72
5.3 REVIEW OF RESEARCH QUESTIONS.....	75
5.4 CONCLUSION.....	78
5.4.1 DESIGN FACTORS.....	79
5.4.2 SOCIO-TECHNICAL FACTORS.....	79
5.5 RECOMMENDATIONS FOR FURTHER RESEARCH	79
5.6 RECOMMENDATION FOR PRACTICE	80

REFERENCES	82
APPENDIX 1:	93
APPENDIX 2	95
APPENDIX 3	97
APPENDIX 4:	99
APPENDIX 5	103

TABLE OF FIGURES.

Figure 1: Hierarchical levels of an activity (Leont'ev, 1981).	31
Figure 2: Examples of activities, actions and operations (Adapted from Kuutti, 1996).	32
Figure 3: Third generation AT Interactions for secondary research question.....	34
Figure 4: Structure of Human Activity (Leont'ev, 1978).....	35
Figure 5: Mediation model (Vygotsky, 1978)	35
Figure 6: Activity triangle model (Engeström 1987).....	36
Figure 7: Activity System for Study.....	37
Figure 8: Third generation AT Interactions for 2nd research question.....	38
Figure 9: Conceptual framework of Study.....	41
Figure 10: Conceptual framework of Study.....	42
Figure 11: Model on the use of Activity theory in understanding perception of eContent design..	43
Figure 12: Screenshot of FLVS LMS	48
Figure 13: An excerpt from the Biology lesson on “the Origin of Life”	49
Figure 14: Activity notation for study.....	50
Figure 15: Activity triangle Model (Engeström, 1987).....	61
Figure 16: Activity System for Study	64
Figure 17: Conceptual framework.....	69
Figure 18: New Framework of Study	74

Chapter 1: Introduction

1.1 Overview

In this chapter, the rationale of the study will be discussed and the research questions stated. The research aims to use activity theory to understand how learners perceive the design of eContent that was developed in a different sociocultural context and how perceptions of electronic content (eContent) mediates the learning of science by secondary school learners at Peddys Victory Secondary School in Cameroon. The introductory chapter comprises the introduction, rationale of the study, a background to the Cameroon context, research questions, theoretical arguments, research aim and objectives, research methodology and also the significance this study will have.

1.2 Rationale of Study

This study is aimed at understanding the relationship between perceptions of electronic content (eContent) design, its effect on use amongst secondary school science students and how it effects the way in which students" learn science. In their research, Hosam *et al* (2015) noted that the interactivity afforded by a good design of electronic content has the potential to impact positively on educational outcomes by improving perceptions. The higher the user satisfaction and positive experience, the higher the intention to use the system (Petter, De lone & Mclean, 2008). Because the performance of learners can be directly related to how they perceive the design of eContent in online learning, it is important to analyze how they perceive this design and to determine whether perception plays a role in increasing or decreasing user interaction with these resources. Activity theory is used as a theoretical framework because it can provide a good understanding of how perception of eContent mediates how subjects engage with this content and some of the contextual factors which can either hinder or promote such engagement. EContent, sometimes packaged and referred to as electronic learning objects, is content that is delivered digitally to students. Definitions

models and theories to define what electronic learning objects are, as well as standards and guidelines for the production of 'good' eContent need to be found and adopted successfully (Aedo & Landoni, 2003). Generally, eContent should be designed to engage student interest (Aedo & Landoni, 2003) as this has the potential to facilitate the learning process. The rich multimedia that can be incorporated into the design of eContent can engage student interest by aiding in the representation and explanation of key phenomena. This is not always the case when using a standard textbook. However, this multimedia material might be context specific and could be perceived differently within different contexts. It therefore becomes important for research to focus on how secondary school students perceive eContent and how this perception affects their use of it, in order to better design content that increases usability. Several factors, including information quality, net benefits, user satisfaction and the intention of the user to use it can have an effect on user perception (De lone & Mclean, 2003). Rich multimedia supported by eContent has the potential to improve students' academic achievement when accompanied by good pedagogy (Aloraini, 2012).

1.3 The Cameroon Context

In Cameroon, paper-based learning resources or materials are still contextually relevant due to the poorly developed ICT infrastructure in most regions. In the late 1990"s, the use of ICTs in schools was almost nonexistent, although private secondary schools made an effort to incorporate Information Communications Technology (ICT) in both teaching and learning Ngajie & Ngo-Mback (2016). However, ICTs were only introduced in Cameroonian schools in 2001 and since then these schools have adopted various initiatives to ensure continuous use, such as the introduction of ICTs as a subject in general, technical schools teaching ICT subjects, and providing presidential grants in the form of multimedia resource centers with good internet connections (Mbangwana, 2008). However, even though 96.23 per cent of public primary school pupils and secondary school students are taught ICT lessons and 100 per cent of Teacher Training Colleges

teach ICTs to student teachers, a greater part of the training is still theoretical due to the chronic lack of resources and infrastructure (Nkwenti, 2015). Despite the problems faced by schools and learners due to bad ICT infrastructure, the number of learners in Cameroon accessing courses online has increased steadily over the last few years (Ngajie & Ngo-Mback, 2016).

1.4 Background of Study

The design of learning environments shapes how users experience the learning process (Dodd, 2015). Learning environments including the design of eContent are important because there is a connection between the environment where learning happens and the quality of our learning experiences (Dodd, 2015). Generally, we have to assume that everyone brings a unique set of personal experiences with them into any learning environment. They have different experiences and different interests and are generally motivated by different things. Apart from the experiences brought by individuals, the context within which learning happens is also very peculiar. As Lim (2002:411) puts it, learning must be studied within the broader context in which it is implemented. Learning, an extremely complex phenomenon in the context of a single person, can become exponentially more complex in group settings. If the environment is not perceived as designed to support flexible or diverse learning experiences, it can lead to frustration, inefficient learning processes, or decreased motivation to learn. This can generally lead to a poor perception of the learning environment (Dodd, 2015). Learners face internal tensions and contradictions within this new learning environment as their socio-technical context has been changed by introducing eContent. Cultural Historical Activity theory is supplemented by Activity theory as a theoretical framework for understanding and analyzing how learners perceive the introduction of eContent into their learning environments. Culture in this case premises that humans are encultured, and everything people do is shaped by and draws upon their cultural values and resources (Foot, 2014). Historical used in conjuncture with the word cultural gives the indication that

culture is grounded in histories which evolve over time hence analysis what people do now must be viewed in light of the historical trajectories within which their actions take place (Foot, 2014). Activity, is therefore not independent of culture. Activity theory therefore offers a perspective for analyzing diverse human practices as development processes in which both social and individual processes are interlinked (Engeström, 1999). In the learning of science using eContent, learners interact with one another as well as with eContent. Learners are also moving from the use of paper content to the use of eContent for learning. EContent as a tool, therefore, mediates learning with the learners engaging in the activity within their learning environment. In every learning environment, the way in which learners go about learning, the tools they use and how they interact with these learning tools goes a long way towards affecting their perceptions of what they learn. CHAT therefore provides a framework where we can analyze how learners perceive interactions between eContent and their learning environments. This framework includes the economic, historical, cultural and political dimensions of the interactions (Foot, 2014). In CHAT, activity is centered on a community rather than individuals. It involves the community working together in a persistent manner by interacting with one another within the context in which they exist (Foot, 2014). Similarly, in this study, a group of secondary school science learners in Cameroon used eContent to learn science. However, simply analyzing what learners are doing with the eContent learning tool does not constitute an activity system. The activity of learning represents a complexity within the whole system that encompasses the multiple cultural, historic and economic dimensions within which the learners find themselves. In order to fully understand how learners', perceive the use of eContent for learning science, it becomes important to understand how eContent mediates this activity. It also becomes important to understand the contradictions which occur within this activity system. The contradictions and tensions that occur internally within the activity system precipitates change and development and also brings forth opportunities for innovation and new ways in which the activity can be structured

and enacted (Foot, 2014). These contradictions can therefore provide new insights and approaches as to how eContent should be designed for use in Cameroon and other developing communities.

1.5 Research Questions

In this dissertation, the primary research question is:

1. What are the social conditions that influence students' perceptions of eContent? In what way does student perception of eContent affect its use?

The secondary research questions are as follows:

2. To what extent does eContent designed outside Cameroon mediate the learning of secondary school science in Cameroon?
3. What are the contradictions encountered in the use of static eContent and interactive eContent?
4. How do learners perceive design aspects such as the role of social media in engaging with Content?

Below is a table showing the research questions, motivation for research questions and sources of data;

Table 1: List of Research Questions

Research Question	Motivation for Research Question	Sources of Data
<p>What are the social conditions that influence students' perceptions of eContent?</p> <p>In what way does student perception of eContent affect its use?</p>	<p>Interaction with a tool such as eContent is framed by multiple context including but not limited to economic, cultural and social aspects (Foot, 2014)</p>	<p>Individual Interviews</p>

To what extent does eContent designed outside Cameroon mediate the learning of secondary school science in Cameroon?	Humans are enculturated hence we draw upon cultural values (Foot, 2014) and resources on how we learn. Therefore, eContent designed out of Cameroon will have cultural aspects specific to its designers and we need to balance how we engrave this within another culture.	Individual Interviews
What are the contradictions encountered in the use of static eContent and interactive eContent?	CHAT also uses the term historicity to show that societies are bounded in histories (Foot, 2014) therefore we must analyse what people do at any point in time based on historical trajectories in which their actions take place. In this study, learners are moving from using paper content to the use of eContent.	Individual Interviews
How do learners perceive design aspects such as the role of social media in engaging with Content?	In CHAT, "community" is central to the process of making and interpreting meaning hence all forms of communicating and learning (Vygotsky, 1978). Social media provides this kind of community in online learning.	Individual Interviews

1.6 Research Aim and Objectives

The aim of this study is to understand how secondary school students perceive the design of eContent from the theoretical perspective of activity theory. In order to ensure that learners are actively engaged in learning, it is necessary to determine students' perception of the use of the electronic content that is accessible both online and offline. This is important as inappropriate use of instructional technology can negatively affect students' learning (Phillips, McNaught & Kennedy, 2011).

Activity theory uses human action as the unit of analysis because actions are situated within a particular context and understanding these actions requires them to be studied within this context (Leontiev, 1978). CHAT views tools, in this case eContent as crafted within a particular point in time and could be adopted over time. Adoption and development of this tools i.e. eContent is shaped by needs, norms and values within that culture (Foot, 2014). The context within which Cameroon learners study with eContent is affected by several factors such as poorly developed internet and ICT infrastructure and frequent power cuts and this could have an effect on how a particular tool is adopted. Despite these possible impediments to adoption of eContent for learning, digitally designed content facilitated by social media and other back-channel communication design features can be engaging in learning communities. Furthermore, the use of rich interactive multimedia such as videos and pictures as a design feature, may improve learner perception of eContent. The Activity Theoretical model is therefore suggested as a theoretical framework for this study as we can better understand perceptions learners have as they interact with eContent and how these are affected by their context. From the above aim, the following objectives were derived:

- 1) To understand and investigate how contextual factors such as poor ICT infrastructure affects learners' perceptions of the use of eContent.
- 2) To investigate how other back-channel communications afforded through the use of social media can affect learners' perception of eContent.
- 3) To investigate how the use of multimedia in designing eContent affects learners' perceptions.

At the end of this study, a greater understanding should have been developed on how eContent can be better designed to improve student perceptions in developing countries like Cameroon.

1.7 Research Methodology

This study was borne out of the need to implement the use of eContent to learners in Cameroon. Because this had never been done before, learners had no prior exposure to eContent. At the time, it was most appropriate to allow a group of learners immerse themselves in the use of eContent and later adopt qualitative research methods in the form of interviews to get feedback on their experiences. The aim was to collect specific information about the learners' context and how they perceived the design of eContent. In using interviews, a set of pre-determined questions were prepared for the learners who took part in the study. After they had used eContent, their responses to the interview questions were collected and analysed using activity theory. The primary activity therefore involved allowing learners to study using electronic content designed in the United States. These learners had been accustomed to learning with paper based learning materials so it was possible to get their perspectives based on their prior experiences of learning with paper. All the interviews were audio recorded and transcribed prior to being analyzed. Details of the methodology used in this study are given in Chapter 3 of this dissertation.

1.8 Significance of Study

The findings of this study could be useful in informing course designers in African countries on the importance of considering learner needs when designing learning content. This knowledge could enhance instructional design strategies to improve learning using eContent in developing countries in general and Cameroon in particular. It could also reduce the dependency on eContent that has been designed elsewhere. Furthermore, findings arising from this study could help education specialists, education planners and curriculum developers to align digital learning to their learners needs.

1.9 Dissertation Outline

Chapter 1: Setting the scene

The introductory chapter comprises the introduction, rationale of the study, a background to the Cameroon context, research questions, theoretical arguments, research aim and objectives, research methodology and also the significance this study will have.

Chapter 2: Literature Review

In this chapter, relevant literature is reviewed as well as theories that speak to the study aims. Activity theory is examined in detail and relevant research on how “perception” affects “use” is also examined.

Chapter 3: Research Methodology

The research methods used for the collection of data are discussed as well as ethical considerations during this data collection process. The chapter also justifies why interviews were the preferred method of collecting data.

Chapter 4: Data Presentation and Analysis

The data that was collected is presented and analyzed in this chapter using activity theory.

Chapter 5: Findings, Conclusions, and Recommendations

Research findings are discussed in this chapter. Also, conclusions drawn from this study are presented and recommendations are made from the research findings.

1.10 Chapter Summary

This chapter discussed how CHAT can be used as a theoretical framework to understand learners' activities within a particular context or, in this case, within a particular learning environment. It alluded to how important context is for learners using electronic or digital content. Also, eContent designers should take into consideration the context within which the future users of eContent will learn. In this case study, eContent can be an important mode of learning using ICTs but the design and the context within which this eContent is used can have an influence on how learners perceive it. The following chapter will look at the literature review and the theoretical framework informing this study.

Chapter 2: Literature Review and Theoretical Framework

2.1 Introduction

This chapter reviews literature in the field of eContent, online learning and some emerging technologies discuss and research on the design of online learning environments within a particular context. It explores the importance of making eContent design relevant within the context in which it is used. The concepts of learning environments, emerging technologies, the role of social media in eContent design, the perception of design, Integrated Learning Design Framework for online learning and activity theory are discussed in relation to eContent design. The aim of this chapter is therefore to gain a greater insight into how these concepts relate to the design of electronic contents and how this has an influence on learners' perceptions. Thus, this section is divided into two sections; the conceptual and the theoretical frameworks that underpin the study.

2.2 Conceptualization of eContent

Nowadays, learning content in a digital form can be produced by experts and then used repeatedly for teaching students. Over the years, international standard organizations and other private educational initiatives around the world have recommended designs for accessible eLearning contents (World Wide Web Consortium, 2004; ADL, 2005; Hodgins & Duval, 2002). Some of the indications of this research specify certain characteristics of eContent that can improve its appropriateness for learning and also the perception of its learners. These include:

Usefulness: This is closely related to the concept of the necessity of matching the content to the end users or learners' needs. In order to increase overall usability and improve perception of eLearning content, the learning material needs to be useful to the learner (Hodgins & Duval, 2002).

Appropriateness: This is related to the selection of the right content while taking into account the requirements of the learner (Hodgings & Duval, 2002)

Effectiveness: This is related to the capacity of the learning material to enable the learner to achieve his/her learning goals. Interactivity of eLearning content using Web 2.0 tools and social networks where learners can interact with each other beyond the classroom as well as with electronically produced content facilitated by information communication technology can go a long way to foster the effectiveness of eContent. Mobile devices and other emerging technologies allow students to continue their studies in a 'familiar' learning environment wherever they are (UNESCO, 2012). Content for online learning is usually delivered electronically through a learning management system, for example Moodle¹. Learning using eContent has been an effective innovation in online learning because it incorporates information and communications technology (ICT) to produce a learning situation where instructors and learners may be separated by physical distance, time, or both (Raab, Ellis, & Abdon, 2001), but are still participating in the learning experience.

2.2.1 Perception of eContent

There has been very little research done on students' perception of eContent within secondary schools Bhagat *et al* (2016). A number of products and prototypes for assisting teaching and learning have been produced and educational material such as open educational resources (OER) have been extensively published electronically. However, it is still unclear to what extent this is of use to students and lecturers/tutors when it comes to real teaching and learning (Aedo & Landoni, 2003). This could be as a result of the fact that there is still very limited use of eContent for teaching, mainly because most schools in developing countries do not have the resources to adopt its use. Even in cases

¹ Moodle is the LMS through which the eContent of Florida Virtual School is delivered.

where eContent is used for teaching and learning, several factors such as management of the eLearning platform, innovativeness of the teacher, and functionality and usability can affect its use. However, eContent still presents a sustainable alternative for learning because digital content can easily be stored, shared, reused, modified and accessed by learners, teachers and designers. With the advancement in information and communication technology (ICT), the internet plays an important role for accessing instruction from anywhere (Baki, 2013).

Although there has been an increase in the use of the internet in higher education (Judd & Kennedy, 2010), there is still very limited use in secondary schools in developing countries. Zhu, McKnight, and Edwards (2009) described online instruction using eContent as any formal educational process whereby the instruction occurs when the learner and the instructor are not in the same place and where internet technologies are used to facilitate communication between the instructor and the student. eContent used for eLearning in secondary schools needs to be designed with the learners in mind and their context needs to be understood by the instructional designers. To take full advantage of active, reflective and interactive learning, the learning environment needs to be designed in such a way that learning is situated within context, it is learner-centered and there should be pre-planning of learning activities (Zane, 2002) bearing in mind that technology not only delivers content (information), but it has the capacity to trigger and stimulate chances for knowledge construction within a particular context (Chih-Hsiung, 2002). Context can be referred to as the characterization of an entity, a place, a person or computational objects using information about their surroundings (Schilit, Adams & Want, 1994). Context can also be defined from a learner and a service perspective. From the learners' perspective, context is defined as the surrounding environment affecting learners' web services discovery and access; for example, learner profiles and preferences, the network channels, and devices learners are using to connect to the Web, etc. From the services perspective, context is defined as the

surrounding environment affecting learning services delivery and execution, such as service profiles, networks, and protocols for service binding, devices and platforms for the service execution (Yang, 2006).

To bring about sound pedagogy, pedagogical principles have to be considered by designers when engaging in the process of constructing eLearning material and associated activities. This view is supported by Papert (1993) when he notes that as ICT is introduced into the socio-cultural setting of schools it “weaves itself into learning in many more ways than its original promoters could possibly have anticipated”.

A good approach to improving learner perception of eContent will involve learners co-creating their own eContent and building on their existing knowledge through problem solving as seen with constructivists learning environments where learners are regarded as active participants in the learning process and also believe that knowledge is gained through the learners’ own interpretation of information that is received and processed. Constructivist approaches are based on the belief that knowledge is personally constructed, and constructivist learning environments provide learners with the ability to build their own knowledge (Lowerison & Cote, 2007). Rather than instructing learners on what to do, they are allowed to construct their own knowledge (Duffy & Cunningham, 1996). Constructivist approaches to learning help learners set and meet their own learning goals in environments that are flexible or even automatically adaptive to their learning needs (Lowerison & Cote, 2007:435). Through analyzing learners’ perception of the design of eContent, the research will better understand issues faced by learners when studying with eContent designed in a different context and how this affects their construction of knowledge.

2.2.2 How Perception affects use

Learning and using eContent in most developing countries does not only depend on eContent design. Even with means, skills and sufficient engagement with online to support the form of eLearning that promotes the use of eContent, individuals may be prohibited from doing so due to lack of a usable telecommunications infrastructure (Haythornthwaite, 2007). Hung, Chou, Chen, and Own (2010) also pointed that online learner readiness should include technical computer and internet skills and also learner control over the sequence and selection of course materials. Apart from this, other factors such as instructional characteristics, social presence, instructional design and trust formed some of the most important factors influencing learners' perception of the use of eContent Bhagat *et al* (2016). Usually, the challenge in Africa is finding a learning technology that is affordable, easily adoptable by novice computer users, functional in environments in which electricity, internet connectivity and landline or cellular telephony might be limited or unavailable, and dust, glare and other unfavorable conditions are the norm (SATTELLIFE, 2005:21). Successful computer based learning with eContent, or learning with ICTS depends a lot on developing learning resources that are efficient and also engaging enough to promote the development and acquisition of new skills and bring about understanding of the concepts being learnt (Sambrook, 2001). In their research, (Sambrook 2001) categorized learners' perception of computer based learning resources into five distinct dimensions. These could be '*general issues*', '*issues with access*', '*issues with design*' which emanate from the quality issues concerning the learning experience and the learning outcomes. While this research will focus on the design issues of electronic content, it also takes into consideration the context within which this electronic content is used, hence employing the activity theory's theoretical framework for analysis. In his proposal, (Davis, 1985), suggested that users' motivation can easily be explained by three factors, i.e. How they perceived ease of use, their perception of usefulness, and the attitude they have towards using the system. All of these are influenced by

system design characteristics. Perception is what you know about a problem and all judgments made are based on this perception, hence design of eContent cannot be considered without context within which eContent is used. A bad perception about internet connectivity, computer infrastructure or eContent design (problem) can lead to a low use of eContent while a good perception can also improve use. Furthermore, approaching the study of ICTs in Education from a socio-cultural perspective precludes the view that ICTs can be studied in isolation. ICTs must be studied within the broader context within which they are situated (Lim, 2002:411). Considering the fact that the use of ICTs for learning does not exist in isolation, research studies in ICTs need to shift their focus towards to the configuration of activities and interpersonal processes taking place in the context within which ICTs are used (Lim, 2002:411). This perception of research in the use of ICTs in learning also applies to the use of eContent. Students' culture, perception and broader socio-cultural context can greatly affect how eContent is being used for learning. Apart from this, eContent designers' perception of how students learn/use eContent can greatly affect how eContent is designed. Park and Hannafin (1993) argued that technological capacity, know-how and the intuition of designers drive the design of multimedia materials rather than research and theory (Herrington & Oliver, 2000:25), therefore designers are prone to designing eContent which does not resonate with the context of learners. Teachers' use of eContent for teaching will also greatly affect how students learn. Students may have to rethink the way they approach the task (learning) and assess how best to use the new tool (eContent) to carry out the task (Lim, 2002:412). The need for analyzing learners' perception is also important because most ICT packages do not have significant effects on learning and teaching activities in schools due to the fact that only a minute proportion of their potential is used (Draper, 1998). Apart from this, eContent, which is a mediational tool, is a product of historical, cultural and institutional forces that may have no obvious relevance to the local settings in which they are employed (Lim, 2002). Analyzing learners' perceptions as they use eContent in learning

can improve the knowledge base available to content designers and teachers. Salomon (1993:189) proposed that “no tool is good or bad in itself; its effectiveness results from and contributes to the whole configuration of events, activities, contents and interpersonal processes taking place in the context of which it is been used”.

2.4.3 Perception of eContent design:

A transition from epistemology (knowledge) to ontology (being) suggests media and technology need to be employed to serve in the development of learners capable of participating in complex learning environments (Siemens & Tittenberger, 2009). Multimedia technology that allows for instructional presentations involving animation and narration is currently available and are used for learning. Stand-alone multimedia CDs and Web-based multimedia presentations are becoming commonplace in instruction (Mayer, 2004). A major task facing all designers of instructional multimedia is that of maximising this experience for the learner, that is of describing and creating an interface that is intrinsically motivating, interactive and correspondingly imposes a minimum cognitive load on the learner (Stoney & Wild, 1998). Reeves (1993a:107) considers that one of the major benefits of a properly designed multimedia learning environment is its ability to include "opportunities for simulated apprenticeships as well as a wealth of learning support activities". eContent is made up of rich interactive multimedia learning material. Interactive Multimedia (IMM) is a relatively new educational innovation in primary, secondary and tertiary-level classrooms (Herrington & Oliver, 1997). Interactive Multimedia combines computer hardware, software, and peripheral equipment to provide a mixture of text, graphics, sound, animation, full-motion video, data, and other information. These have been the primary area of focus for most eContent designers and are known as learning objects (LO). From an instructional design perspective, learning objects represent the opportunity to customize instruction without having to replicate and reinvent core content as opposed to ‘one size fits

all' textbooks and pre-packaged materials. LOs theoretically allow maximum flexibility in customizing content and pedagogy to fit the demands of the situation and the individual needs of the learner (Lowerison & Cote, 2007). In the IEEE's definition, reusability is a key characteristic of learning objects. Other such characteristics include:

- Flexibility: ease of making updates;
- Accessibility: ease of use and locating;
- Durability: ability to retain durability over a long period of time;
- Interoperability: ability to be used on a variety of platforms or course management systems;
- Sharability: Content from several different sources may be accessed by multiple users (simultaneously) with different e-Learning systems; and
- Activity-sized based: large enough to be used as an activity within a lesson or module, or large enough to be a lesson by itself.

Siemens & Tittenberger (2009) give a quick review of media selection and design related concerns that provide a glimpse of the current thinking of media and technology and this includes:

- Cognitive load theory which states that the brain processes different media, i.e. audio and images differently resulting in "instructional implications of this interaction between information structures and cognitive architectures";
- A focus on "perception and action" (rather than memory and retrieval) produces a "very different conceptualization of instructional design". Using technology for active learning requires different approaches from those used for knowledge acquisition;
- The complexity of situated learning is reflected in the view that "real-world situations are much more complex and ill-structured than most

instructional systems reflect, and that these underlying biases and assumptions in the design of instruction leads to poor learning”;

- To be successful in implementing educational technology, designers and educators must balance learning needs, context and affordances of tools. Selection of one media format over another is not sufficient. A holistic view of media, learners and context is required;
- Instead of emphasizing media and technology selection, contextual analysis may be a more critical first task; and
- The traditional view of the role of education as planned enculturation is at odds with the view that knowledge emerges “as human beings participate in the world”.

Multimedia can be used in learning by supplementing printed words with images. In research done by Mayer (2004), a question that was asked was: what could be done to overcome the problem of good verbal explanations leading to a lack of understanding by learners (Mayer, 2004:34). The adding of visual modes of explanation to verbal ones was suggested as a potentially new solution. The kind of multimedia used in the design of eContent for eLearning or Mobile Learning (m-learning) is very important because this can either positively or negatively affect learners’ perceptions. For example, using high definition videos in the design of eContent for us in developing communities which have low internet bandwidth can cause difficulty for learners trying to access learning material and this will negatively affect their perception of multimedia eContent.

2.5 Emerging technologies and use of social media in design

The use of emerging technologies by learners has the potential to promote a number of authentic learning characteristics such as collaboration across distance, sharing of results, communicating with experts and access to online research communities Herrington *et al* (2010). Collaboration seems to be an important factor for emerging technologies which can provide authentic learning

experiences e.g. social networking tools Herrington *et al* (2010). Social presence can help the instructional designers to maintain the quality of the online learning experience, which is consistent with classroom instruction Wei *et al* (2012). Contemporary social technologies are used by thousands of learners and the fun aspect consistent with their use also makes them engaging and this has been harnessed for teaching and learning and particularly for facilitating social interactions (Seaman & Tinti-Kane, 2013). In their research, Suraya, Jenny, Sherah, Shanton (2014), found that students believed they experienced greater interaction with other students and their lecturer when they used social technologies. They also perceived that they improved their own mastery of the course content when compared to their other classes that did not use social media. The use of social media is user-driven and usually does not depend much on pedagogy but on the users. Social media can provide engagement between users of eContent and can affect how learners perceive the design of such content.

In addition to exploring learners' interactions with social networking sites, other emerging technologies such as mobile technologies, instant messaging, cell phones, e-readers, social networking, RSS feeds, podcasts, and tablets can be used in the design of eContent in order to capitalize on the idea of continuous instant access and active engagement with learning afforded through the use of mobile devices Cassidy *et al* (2014). The mobility of these devices means that students are now engaging with learning content in brief spurts, on the-go, in the hallway, during lunch, and even in the classroom itself Cassidy *et al* (2014). Considering the fact that the use of mobile devices such as mobile phones has grown exponentially over recent years, so much so that they now overtake the proliferation of personal computers in modern professional and social contexts (Attewell, 2005), mobile eContent could be an innovative way of learning using traditional eContent. Mobile learning (m-learning) can be viewed as any form of learning that occurs when mediated through a mobile device, and is a form of learning that has established the legitimacy of 'nomadic' learners (Alexander,

2004). Despite the fact that there is wide adoption of mobile devices across Africa in general and Cameroon in particular, Patten, Arnedillo, Sanchez & Tangney (2005) argue that the benefits of mobile learning can be gained through collaborative, contextual, constructionist and constructivist learning environments. Apart from this, it is also important to understand what tools learners use to communicate and also what support network they use, i.e. back channel or effective communication facilitated by social media and chat. Social media could be an important factor in the use of eContent for e-learning or m-learning and could also have an effect on how learners perceive eContent design.

2.6 Designing eContent to improve Perception and Use

Several design methods can be used in the design of instructional material for use as eContent. There is ongoing debate about whether it is the design of instruction that improves learning or the use of a particular delivery technology (Clark, 2001). Instructional design (ID) is the art of creating an instructional environment and materials that will bring the learner from the state of not being able to accomplish certain tasks to the state of being able to accomplish those tasks (Thompson, 2001). The goal of any instructional system is to promote learning; therefore, prior to the development of learning materials, educators must understand the underlying principles of learning and how students learn (Anderson, 2002:6). Although there are hundreds of instructional design models and theories, certain basic common features are shared by all of them (Seels & Glasgow, 1998). Seels and Glasgow (1998), described these as follows:

- Analyzing: This involves defining what is to be learned;
- Designing: This involves specifying how learning will occur;
- Development: This involves authoring and developing learning material;
- Implementation: This uses a real world setting to install material developed; and

- Evaluating: which involves determining the impact instruction has had (p. 7).

Irrespective of the instructional principle employed in the design of eContent, certain design factors that are often associated with the navigation and presentation of learning materials are important when considering how eContent is designed. A user's identification of the benefits and ease of negotiating a tool will contribute to its acceptance (Hosam, Hassan & Fahed, 2012). Attitudes of students towards system representation design can be accessed by different dimensions associated with their behavior in learning activities (Hosam, Hassan & Fahed, 2015). This has led to the acceptance that content representation in e-learning has to consider aspects of interface elements which enable users to locate information easily (Mulienburg & Berge, 2005).

In her research, (Sambrook, 2001) highlighted eight top design issues affecting the use of electronic content. These included:

1. Graphics issues: These include pictures and diagrams;
2. Presentation issues: Design should have no mistakes, and should be clear and accurate;
3. The amount of text in the design and how this balances with graphics;
4. How easy is it to use eContent;
5. Engagement issues and how can this keep users motivated;
6. How color is used in text to highlight key points;
7. Understanding: Ease of use; and
8. Navigation: How convenient it is to move around, i.e. heuristics used in design.

However, the design of electronic content should not only consider these principles, but should also take a holistic approach towards learning by incorporating aspects into design that fit the learning experience by organizing,

specifying and selecting the learning experience needed to carry out a learning task (Horton, 2011). Therefore, learning context is an important aspect of design and the users' perception of design cannot be understood completely by ignoring the conditions within which they learn.

This research is therefore significant as it employs activity theory to understand holistically how design of electronic content affects learners' perceptions and ultimately, learning.

2.6.1 Understanding Contradictions in CHAT and how it affects perception.

Design plays an important role in perception. To perceive something in a different way means to acquire new potentials for acting with respect to it (Vygotsky, 1987, p.190). This is the central thinking behind activity theory, more commonly known as cultural historical activity theory in order to take into account tasks being carried out within a particular context (Nussbaumer, 2012). An activity in CHAT, according to Van Oers (2001) is "any motivated and object-oriented human enterprise, having its roots in cultural history. Environmental surroundings and past experiences commonly referred in this study as 'context' influence the kinds of operations or a form of unconscious actions that are dependent upon conditions chosen by the subject to carry out an activity (Nussbaumer, 2012). Because CHAT takes into account 'historicity' and views human practices at multiple levels as collective and complex (Foot, 2014), it can be employed to understand how the design of eContent within two different contexts by eContent designers can influence learners' perception. This can be understood on the basis of contradictions. In CHAT, four levels of contradictions riddle an activity system and all other systems that are connected to it. The primary Source of contradiction between every activity system is between the use and exchange

value within each of the six nodes of the activity system triangle: subject, tool/artifact, object, rules, community, division of labor (Engestrom, 1987). Use value can be understood as the direct benefits of an activity's outcomes for the activity's participants i.e. learning Science, whereas exchange value denotes the worth of something when it is exchanged for something else i.e. moving from the use of paper content for learning science to the use of eContent (Foot, 2015).

Secondary contradictions occur when two nodes within the activity system conflict with each other, for example, when a tool i.e. eContent is perceived as undermining the agreed upon or ideal division of labor for an activity system (Foot, 2015). In this study, this could be regarded as the conflicts that occur in the classroom between teachers as eContent is introduced. Will they use this instead of personally prepared notes in the classroom? How will this influence on their teaching.

More relevant to this study are tertiary contradictions. Tertiary contradictions arise within an activity system when the object of a more "culturally advanced" activity (Engestrom, 1987) i.e. eContent in favor of 'paper based' Content is introduced within the activity system (Foot, 2015). How does this affect learners' attitudes and perception of learning? Also, how does this affect teachers attitudes to teach? Tertiary contradictions can lead to quaternary contradictions which arise between the central activity and its neighboring activity systems when a new form of practice is employed in the central activity system, based on a reformed and/or expanded object (Foot, 2015). These contradictions that occur within the activity system are important to consider when introducing eContent within the context of secondary school science learners in Cameroon as this will be central to how they perceive this eContent.

2.7 Understanding Activity Theory in relation to this study

Activity theory is a conceptual framework of analysis with the premise that activity is primary, that doing precedes thinking and that goals, cognitive models, intentions, images and abstract notions like 'definition' and 'determinant' grow out of people doing things (Morf & Weber, 2000:81). In this case, the perceptions of the learners can only be properly analyzed after they have engaged in the main activity of learning science using eContent. The main activity here is the method of learning. The analytical components are the *subjects*, *tools* and *objects*. The *subjects* are secondary school students, the main *tool* is eContent and the *object* is their 'perception'. The outcome is the acquisition of knowledge and skills in science through the use of eContent. *Rules* and *Division of Labour* were added as a modification of Vygotsky's original conception of activity theory by Engeström (1987). These additional elements affect the community where teams can work together and be analyzed. In this study, learners are allowed to study in groups using eContent and this allows for the formation of new learning communities and also fosters interaction between students. The rules determine how the secondary school science learner can act while studying and also present the guiding principles needed to belong to the community. The first rule for belonging to this community is that the member must be a secondary school science student who is able to study using eContent. Activity theory regards technology integration as mediating tools for social interaction. These mediating tools, or artifacts, are not limited to machines or computers, but include signs, and language. The individual primarily relates to their environment through the community, i.e. they are part of the broader community. The relationship between the individual and their environment is considered through the component of community. Rules mediate how subjects within this activity system form relationship with the community, while "division of labour" mediates the relationship between object and community (Hettinga, 1998). As a result of

creating eContent, the concept of design held by designers would invariably be reflected in their design. Therefore, mediation by means of tools and other technology is never a neutral process. The tools invariably have an influence over how subjects interact with objects. Leont'ev (1978) envisages activities as a hierarchical system which comprises actions or chains of actions linked together to form operations. Therefore, while the activity includes learning science using eContent, the action is to improve understanding of science concepts and using eContent is the operation. However, a slight deviation from this is made possible by third generation activity theory where another possible operation is using paper content/static content or mobile eContent to learn science. The activity has a motive; in this case, learners are motivated through the need to perform better in science. The action will have a goal, in this case to obtain good grades. Finally, the operation will have conditions, for instance accessing online study material through the use of the internet, utilizing digital content through computers that can be affected by availability of power or electricity, learning using social media and also accessing eContent using mobile devices. This is illustrated in Figures 2 and 3 below.

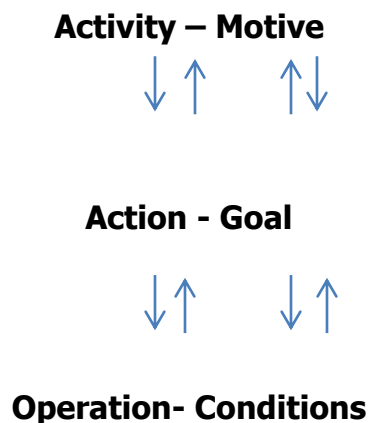


Figure 1: Hierarchical levels of an activity (Leont'ev, 1981).

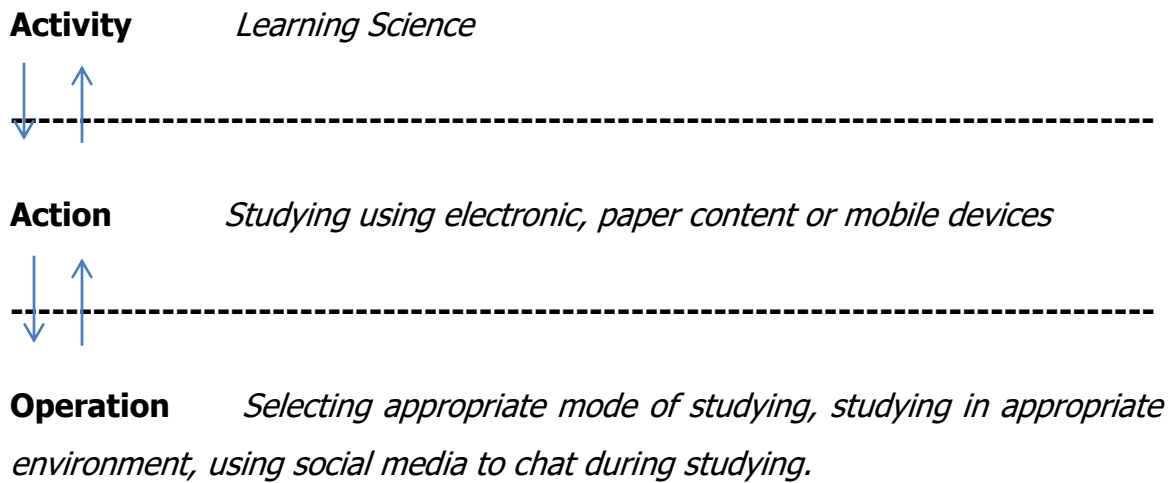


Figure 2: Examples of activities, actions and operations (Adapted from Kuutti, 1996).

Activity, action and operation are all interacting events and therefore can affect one another. They provide a medium through which we can thoroughly understand what prevents or fosters the adoption of an activity within any particular community. This is because the value of the activity theoretical framework stems from the analysis of individuals and of their social interaction within the activity system mediated by tools, rules and division of labour. Interviews might reveal only the explicit actions involved in the process of learning science using eContent and may not necessarily make us understand the implicit motivations of actions and operation.

Activity theory demonstrates the intimate relationships that exist between ICTs, learning and learners' socio-cultural settings (Lim, 2002). Several factors can influence the use of eContent within a particular setting and, as Lim (2002) suggests, ICT studies in schools may focus research on a unit of analysis that allows one to observe actual processes by which cognition and socio-cultural factors shape and are shaped by ICT tools. In this study, the use of eContent by

learners' forms part of an activity system whereby learning occurs - or does not occur - due to social relations between other learners, teachers, eContent and, to a broader extent, designers of this eContent. Activity theory presents a dynamic model for understanding context because there is continuous construction and reconstruction of the components of an activity system. There is an ongoing reformulation of rules by the subjects rather than an adherence by the subject to fixed rules (Lim, 2002:4). Contradictions also occur in the activity system as students experience a change from the use of content in standard textbooks to eContent. This kind of interaction in the activity system is known as third generation activity theory and was described by Engeström (1999) as follows:

An activity system is made up of a community, with multiple points of views, interest and traditions. Division of labour within this activity system creates different positions and circumstances for participants, who have diverse histories. Within this activity system, are multiple layers of history engraved in artifacts, rules and conventions. These multiple perspectives and multi-voicedness is multiplied in networks of interacting activity systems, hence creating trouble and innovation which demands actions of translation and negotiation. (Engeström, 2001:136).

2.7.1 Justification of AT as theoretical framework for this study

In trying to answer the secondary research questions, third generation activity theory will be employed. In third generation activity, the motive force of change and development are internal tensions and contradictions within the system (Engeström, 1999:9) and the transitions and reorganizations within and between activity systems is part of the evolution. It is not only the subject, but the environment, that is modified through mediated activity (Engeström, 1999).

Relating third generation activity theory to this study would involve the tensions that occur and the subsequent transition from static to interactive eContent.

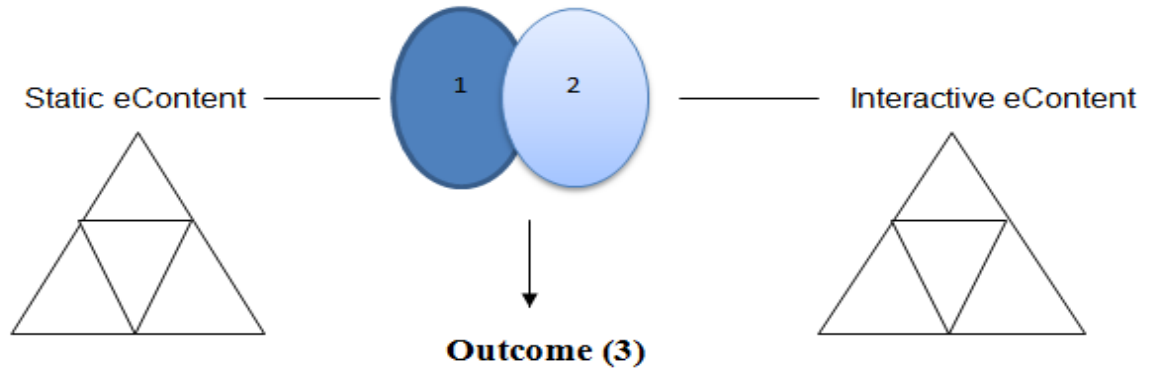


Figure 3: Third generation AT Interactions for secondary research question.

Activity theory had typically been seen in the past as relying on a unidirectional instead of a dialectic view of cultural and individual relationships (Toomela, 2000). The dialectic view for the future of activity theory simply involves a view where ideas are discussed and examined in order to find the truth. Two opposing ideas are compared in order to find a solution that includes both of them. Activity theory is therefore an object-driven activity. Objects are of concern because they bring about motivation and generate foci of attention and efforts. Through their activities, people or communities constantly change, thus creating new objects that might not be the intentional products of a single activity but the unintentional consequences of multiple activities within the community (Engestrom, 2000). Activity theory therefore analyses human practices as developmental rather than as fixed processes with individual and social levels being linked (Kuutti 1996, cited in Mwanza, 2001:4). Activity theory is thus a suitable framework for analysing community engagement based on a particular socio-cultural context. It was initially developed by Leont'ev (1978) (see Figure 6 below), who stated that an activity is initiated by a motive and is made up of one or more actions which, when completed, satisfy the initial motive. Learning is analysed as a cultural-

historical activity system in the traditional activity theory and is mediated by tools that can either constrain or support the learners in their goals of transforming their knowledge and skills (Sharples *et al.*n.d.).

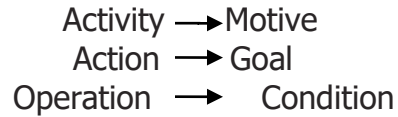


Figure 4: Structure of Human Activity (Leont'ev, 1978)

Vygotsky (1978) postulated in his mediation model (see Figure 5 below), that human beings' indirect interaction with their environment is mediated by signs and tools.

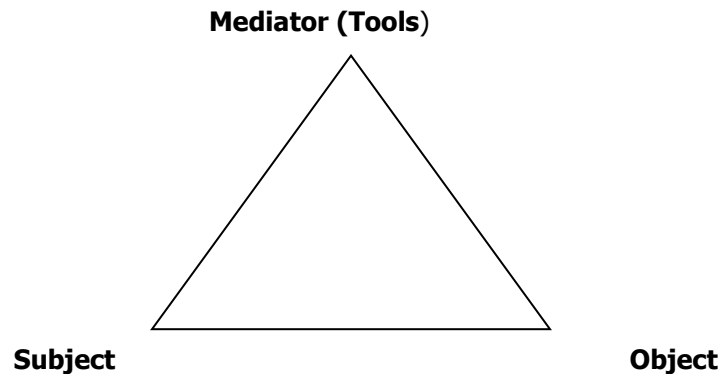


Figure 5: Mediation model (Vygotsky, 1978)

In this model, tools act as mediators in facilitating interactions between objects and subjects. In 1987, Engeström who was inspired by the work of Leont'ev (1978) and Vygotsky (1978) added the cultural and social aspects of human activity in order to come up with the expanded activity triangle, which reflects the collaborative and collective nature of human activity systems (Mwanza, 2001).

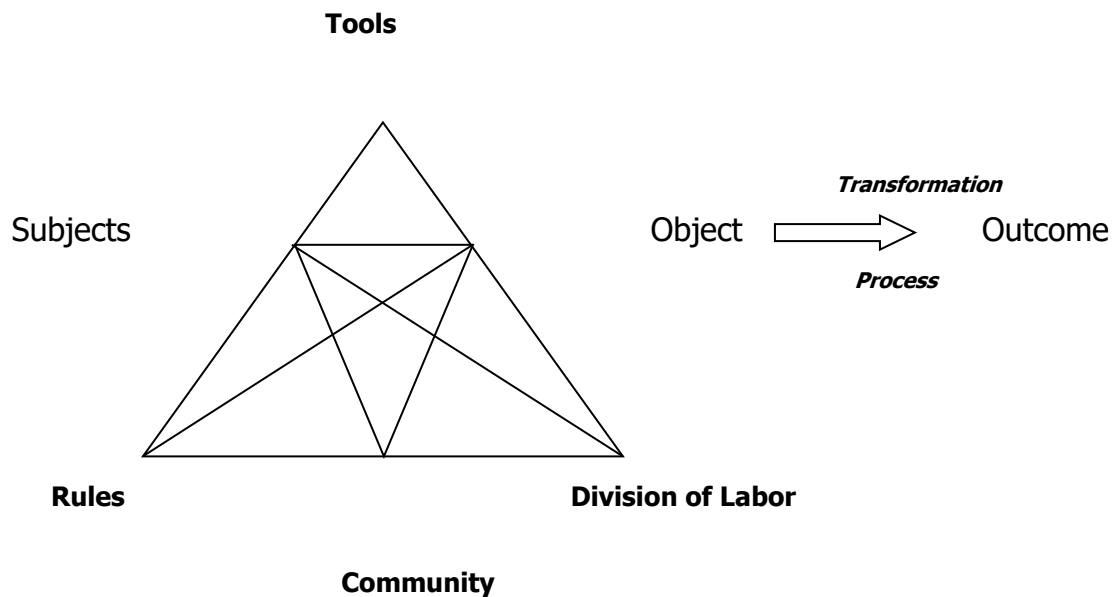


Figure 6: Activity triangle model (Engeström 1987).

This representation of the activity theoretical framework incorporates objects, subjects and community components with mediators of human activities such as rules, tools and division of labour. *Objective* defines reasons for the activity while *Subjects* are those involved in carrying out this activity; the *Tools* involve the means used by the community to carry out this activity while regulations or cultural norms which mediate the performance of the activity are *Rules*. *Divisions of labour* are roles assigned to each person participating in the activity system; *Community* involves the environment within which the activity is carried while *Outcome* is the perceived end product from carrying out the activity.

The activity system of this study would be represented as follows:

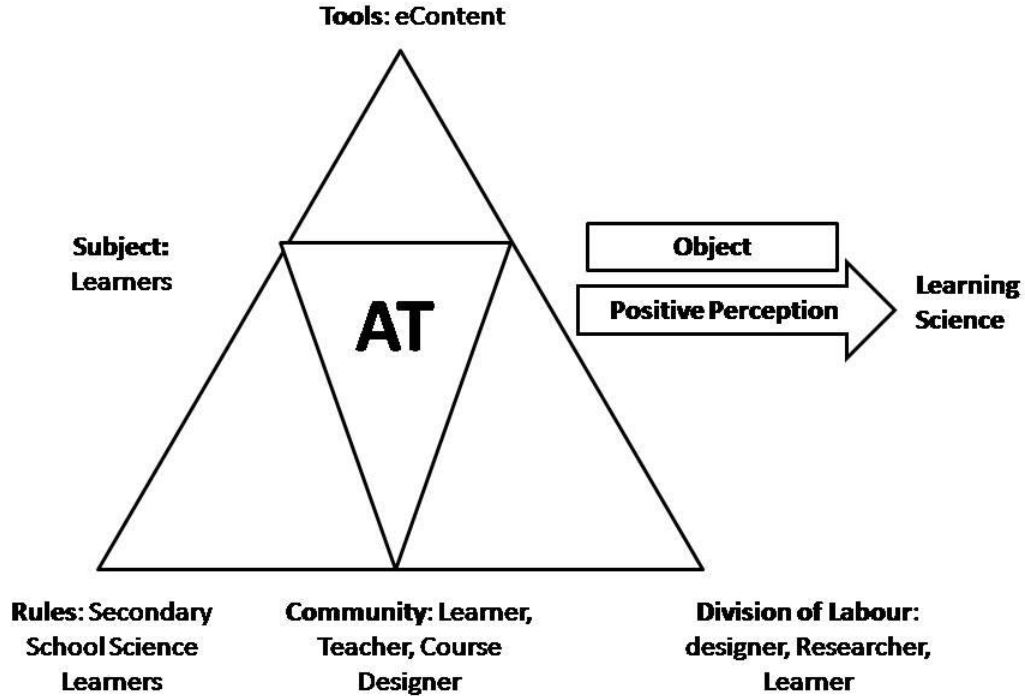


Figure 7: Activity System for Study.

The learning of science is a higher-order cognitive activity which needs consistent pedagogical support and mediation to acquire. Multimedia used in eContent can therefore serve as a form of mediation which will lead to an outcome in which learning occurs. Activity theory can help to understand the process which leads to learning hence it is used as a theoretical framework for this study. In order to answer the secondary research question, third-generation activity theory would be employed which involves an interaction between paper and eContent as tools. In third-generation activity theory, contradictions and internal tensions are the force of change and development (Engeström1999:9) and transitions and reorganizations that occur within and between activity

systems is part of evolution and change; Both the environment and subject are modified as a result of this mediated activity.

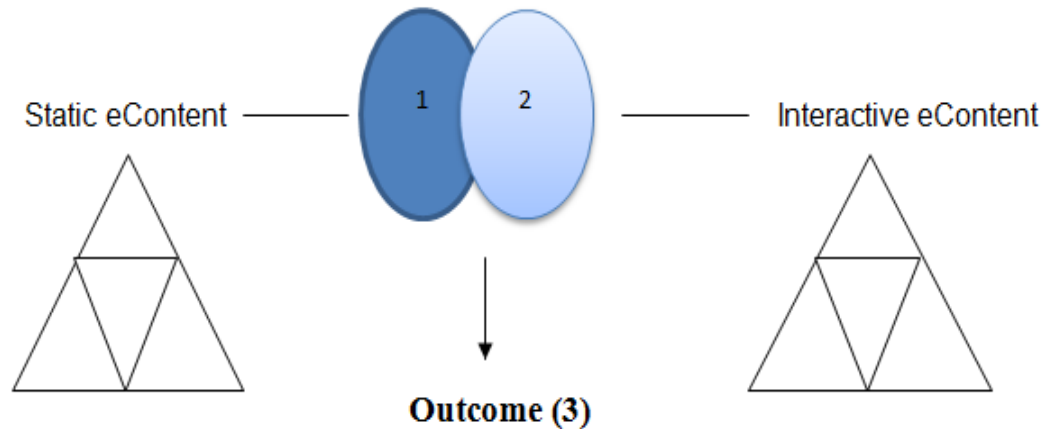


Figure 8: Third generation AT Interactions for 2nd research question.

Third-generation activity theory (AT) is used for this study in order to understand multiple perspectives and dialogues and also the networks of interacting activity systems. In this case it is how students feel about the use of Static Content as opposed to interactive eContent?

2.8 Related studies on perception of learning with eContent

Research into the study of students' perception of the design of eContent has mostly been quantitative in nature Hui-Yin Hsu *et al* (2008). Apart from this factor, other studies by Sharpe, Benfield, Lessner & DeCicco (2005) which have investigated students' experiences with the use of technology, have tended to focus mainly on course evaluations and have minimised students' actual experiences as they used technology. In their study on students' use and perception of technology (Conole, Laat, Dillon & Darby, 2008) used descriptive statistics to observe the basic features of their data set in order to categorize this data and detect patterns in the use of technology in relation to certain learning

activities. These patterns were then analyzed to see if there were differences between the participating subject centers. Dede *et al* (2004) used design-based strategies for studying situated learning in multi-user virtual environments. According to Dede *et al* (2004), design-based research was first detailed by Brown (1992) and Collins (1992) as a way of studying new learning environments in the context of the classroom. Design-based research combines quantitative and qualitative methods to view how designs work in the crucible of practice and to gain insights into how students learn in typical school contexts Dede *et al* (2004). Design-based research simultaneously pursues the goals of developing effective learning environments and using such environments as natural laboratories for studying learning and teaching (Sandoval & Bell, 2004). According to the Design-based Research Collective (2003), design-based research can develop different kinds of knowledge, including better theoretical understanding of the learning phenomena that can be addressed by an intervention and knowledge of useful and generalisable design practices (Sandoval & Bell, 2004). In their study, Dede *et al* (2004) used *situated learning theory* as a theoretical framework. Collins and Brown (1988:2) define situated learning as "the notion of learning knowledge and skills in contexts that reflect the way the knowledge will be useful in real life. Brown, Collins and Duguid (1988) defined it as being embedded within, and inseparable from participation in a system of activity Dede *et al* (2004). In their study, the learners involved are not passively observing the learning material but are actively observing multivariate problems with the help of community members who have various levels of expertise. In other words, the activity system of the study involves learners and expert teachers who assist learners in making sense of the learning material in a multiuser virtual environment. It is important to note here that this learning material consists of multimedia material designed using learning objects. Hosam *et al* (2015) used social cognition theory to investigate the effect of content representation design principles on users' intuitive beliefs and the use of eLearning systems. The concept of self-efficacy that has been derived from

social cognition theory posits that the more convenient a system is to use; the greater the user's sense of efficacy will be Hossam *et al* (2015). In their study, they hypothesized that the system of thoughts and feelings that make up one's self-concept serves to organize and guide personal processing of information. They also noted that people are usually strongly motivated to maintain an internal sense of consistency in their beliefs and self-perceptions. However, when an actual experience is less optimal than an individual thinks he or she is or is capable of achieving, the person will generally experience a pattern of negative emotions, including sadness, dissatisfaction, anxiety or fear Hossam *et al* (2015). Although the concept of design based research, situated learning and social cognition theory does not form part of this study, it brings to light some ways in which other researchers have approached the study of learners' perception as they use eLearning content. The activity theoretical approach used in this study goes a step further to make the claim that, apart from the design factors that influence perception of use, contextual factors such as internet connectivity and infrastructure also affect learners' perception.

2.9 Conceptual Framework

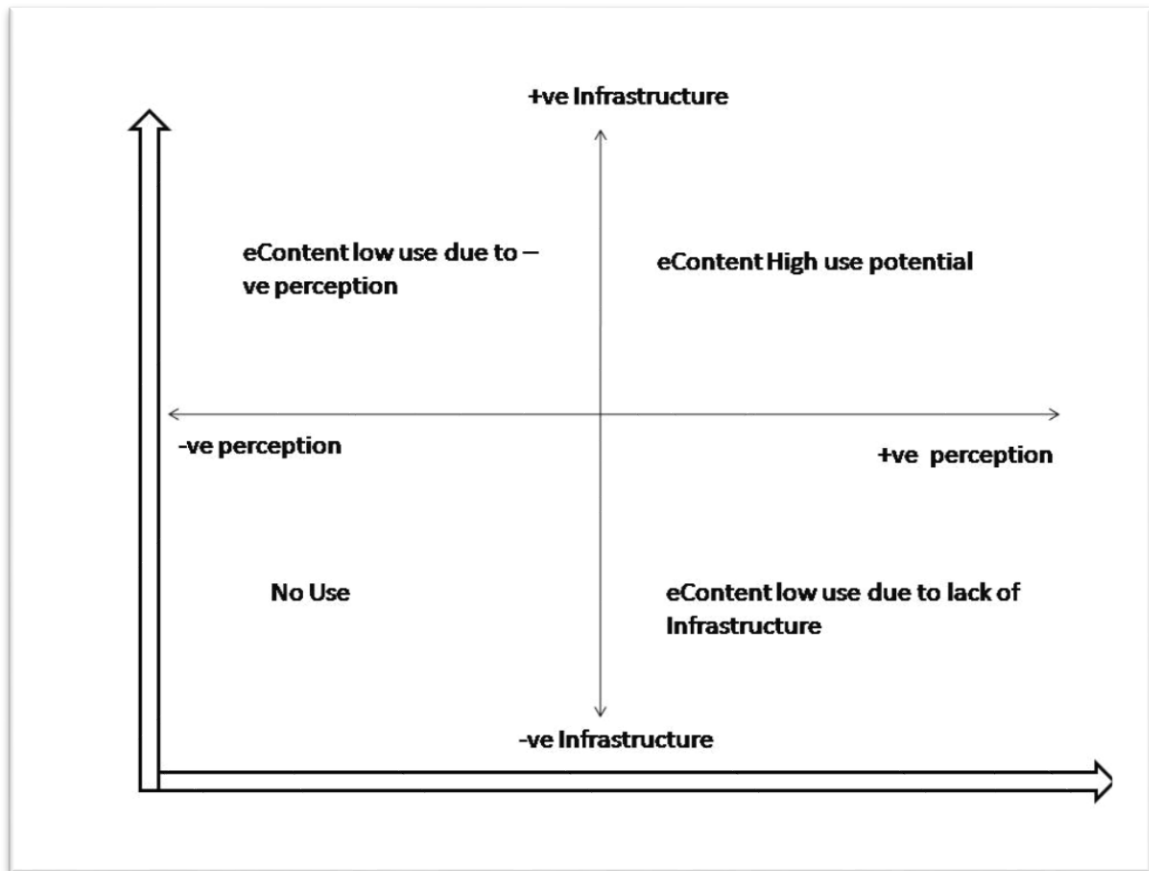


Figure 9: Conceptual framework of Study

In the above conceptual framework, a good ICT infrastructure and positive perception of eContent leads to a high use, while good ICT infrastructure and a negative perception leads to low use of eContent. Similarly, a negative perception coupled with bad ICT infrastructure leads to no use of eContent and a positive perception with very bad ICT infrastructure causes low use of eContent.

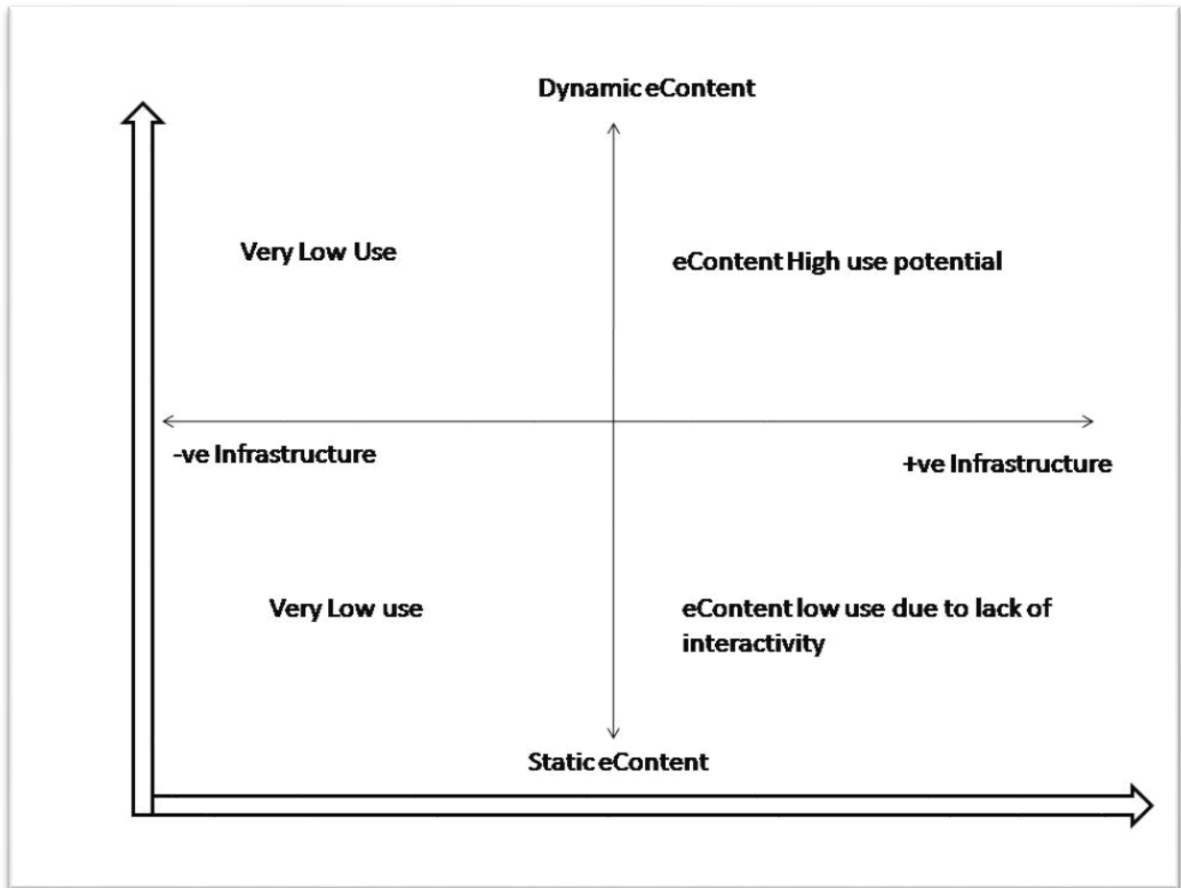


Figure 10: Conceptual framework of Study

The second diagrammatic representation of the conceptual framework deals with the interactivity of eContent that can be achieved by design. Social media plays an important role in allowing learners to form online learning communities as they study with eContent. Good ICT infrastructure with a dynamic eContent leads to high use while good infrastructure with static eContent leads to low use. If the ICT infrastructure is not good, eContent will be underutilized irrespective of how static or dynamic it is.

From the above representations of the conceptual framework, it can be seen that the design of eContent can create either a positive or a negative perception about its use. Interactive eContent, which allows learners to interact freely with

one another and to share ideas, has a greater probability of creating a positive perception amongst users than static eContent. Static eContent is usually bounded by institutional forces and the content is simply 'put out there' for learners to use. Positive perception can lead to positive learning outcomes while negative perceptions can lead to negative learner outcomes. Activity theory as the theoretical framework for this study is used to understand the interactions that occur between eContent and the users of this content.

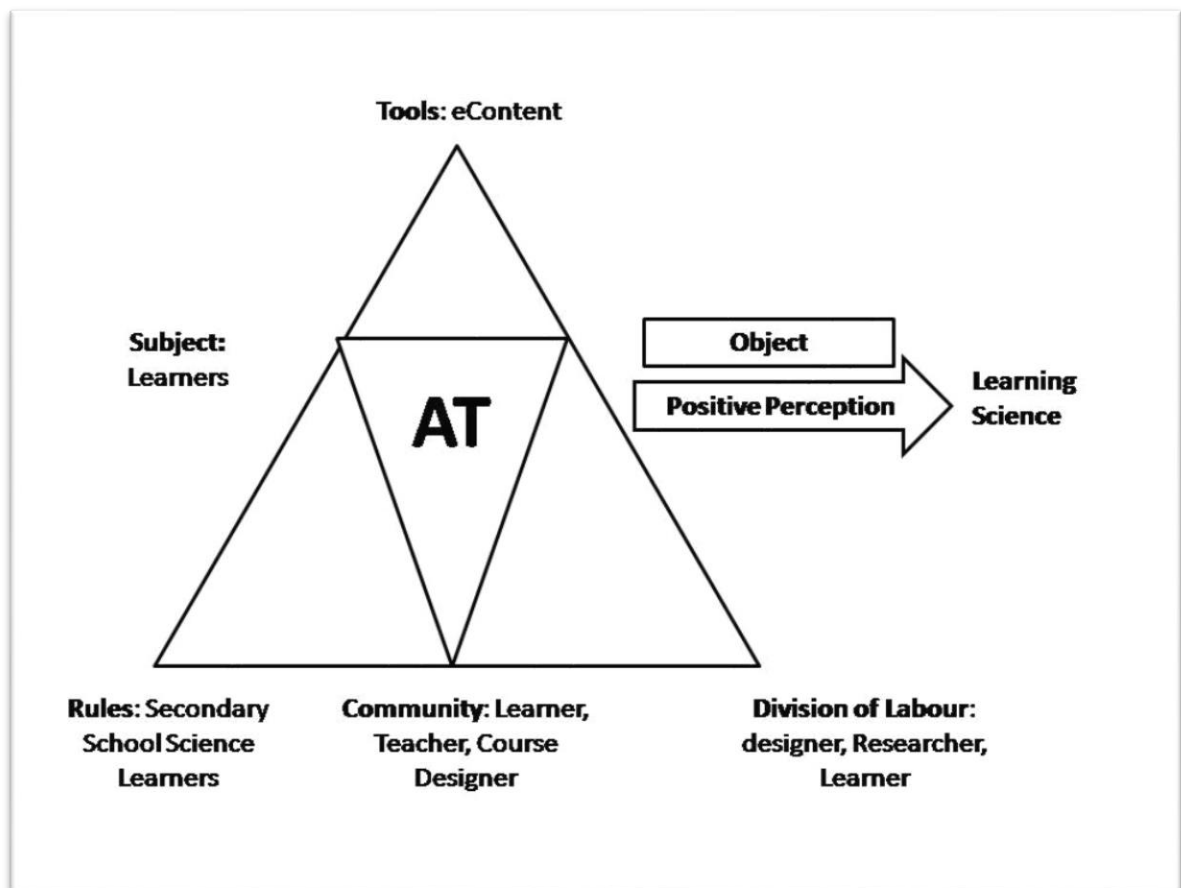


Figure 11: Model on the use of Activity theory in understanding perception of eContent design

eContent as a 'tool' is used by secondary school science learners within a learning community for learning. For a positive learning outcome to be achieved

there is a need for the learners to have a positive perception about electronic content. Several rules govern the activity system. It has to specifically involve secondary school science learners who engage with eContent in the learning community consisting of teachers, the researcher, content designers and other learners.

2.10 Summary of chapter

This chapter has provided a brief introduction to this study which is aimed at understanding how secondary school science students in Cameroon perceive the design of eContent.

Activity theory is used as a theoretical framework for the study because learners interacting with an electronic system do this as a community with other learners and are constantly engaged in a system of learning with rules as set by their learning environment. In the literature review, a definition of eContent is made as used in the study. Also, emerging discourses by other researchers in this research area are discussed. Although there has been very little research on learners' perception of the design of eContent in Cameroon, there is a lot more research being done by other researchers around the world. With the advent of mobile telephones and social media, eContent use can be accessed on mobile devices by learners. Social media presenting an important aspect of learning using eContent as content is easily shared amongst users. From research by prominent researchers such as Davis (1985), perception plays an important role in how students use eContent, hence it is important for them to have a positive perception about the design of the eContent. The integrative learning design framework is also presented as a design method which, if employed, can greatly improve on the perception of design as it takes into consideration the context of eContent users. Lastly activity theory is justified as the theoretical framework for this study because it analyses human practices as developmental processes with a link between individuals and society. It also provides a suitable framework for analyzing community engagement based on their socio-cultural context.

Chapter 3: Research Methodology

3.1 Introduction

Chapter 2 presented a review on literature that mainly comprised the contemporary debates around the use of eContent and multimedia in learning. It also presented activity theory as the theoretical framework of this study. As stated earlier, the activity theoretical framework analyses human practices as developmental processes which are linked at a societal and an individual level (Kuutti, 1996, cited in Mwanza, 2001:4). This makes it a suitable framework for analysing community engagement taking socio- cultural contextual factors as the basis for this analysis. Considering that the study is aimed at understanding students' perception, activity theory was considered as the most appropriate framework because it can provide an understanding of how the learners engage with eContent and some of the contextual factors which can hinder or promote such engagement.

Chapter 3 gives an outline of the research design (3.2), research population (3.3), sampling procedures (3.4), data collection methods (3.5), data analysis (3.6), validity and ethical issues (3.7), research procedure (3.8) and a conclusion. In this chapter, the researcher begins by discussing qualitative research as a philosophical framework of my study. The dissertation then moves on to a broader discussion about the sample used for research, the research site and how the research was designed. The tool used to collect data is also described as well as the data analysis methods. This chapter highlights ethical issues of the research and ends with a brief summary.

3.2 Research design

This study involves a qualitative research design employing a case study approach mainly comprising interviews with the group of learners taking part in the study. An unstructured research approach is employed. Maxwell (2005:80) pointed out that an unstructured research approach - in contrast to a structured approach - allows the researcher to focus on a particular phenomenon which may differ from others and may require individually tailored methods. Interviews trade generalisability and comparability for internal validity and contextual understanding (Maxwell, 2005:80). Participant interviews will be the main methods used by the researcher in carrying out this research. The participants in this study are learners taking online courses through the Florida Virtual School in Cameroon. The researcher is therefore very familiar with the participants and has established a good working relationship with them. The study involves using activity theory to understand students' perception of the design of eContent.

Maxwell (2005:79) noted that 'data' in a qualitative research can include virtually anything that one sees, hears, or that is otherwise communicated to one while conducting the study; there is no such thing as 'inadmissible evidence' in trying to understand the issues or situations that one is studying. As such, interviews were used to probe the participants in the study in order to obtain their perceptions about using eContent, but, as Dexter (1970:17) advised:

... no one should plan or finance an entire study in advance with the expectation of relying chiefly upon interviews for data unless the interviewers have enough relevant background to be sure that they can make sense out of interview conversations or unless there is a reasonable hope of being able to hang around or in some way observe so as to learn what is meaningful and significant to ask.

Hence, participatory action research is employed as the main qualitative research method in this study. Brydon-Miller (2001:5) advocated participatory action research as rational in that it acknowledges and actively involves the relationship between researchers and participants as well as their respective subjectivities. Through this kind of research, the researcher and the researched can work collaboratively to generate knowledge that is useful to both of them.

3.3 Research Participants

Hoyle, Harris and Judd (2002:182) define the research participants as "the aggregate of all cases that conform to some designated set of specifications." In this study, six secondary school students who are currently being taught using eContent were used as participants for the study. These students are currently studying through the Peddys Victory Secondary School in Cameroon and their study materials were supplemented using eContent developed by the Florida Virtual School (FLVS). FLVS is a private community college in the United States of America that provide content through their learning management system (Moodle) which is being used by learners in Cameroonian secondary schools and other home-schooled learners. Learners would be interviewed in order to understand their perceptions of learning science using the Florida Virtual School (FLVS) eContent. It is important to note that this learning material is developed in the United States, and as such it is developed in an environment which is quite different in terms of the culture and Information Technology (IT) infrastructure to the Cameroonian context. In December 2011, there were only about 750,000 internet users (Internet World Statistics), which constituted 3.8% of the total population. Although the Cameroon government is currently promoting the use of ICTs by making it accessible in government and private schools, most schools do not have good computer laboratories or access to the internet. Most learners have to access the internet after school hours from local cyber cafés which charge a fee for use of the internet. Also, the structure of the Cameroonian curriculum is not the same as the American curriculum and concepts taught in life

science in the USA might be different from those in Cameroon, therefore certain knowledge areas in physical science might be different in the design of the eContent from the Florida Virtual School.

3.4 Procedure used to carry out study

A 'demonstration' account which gave access to the FLVS physical science content was used in the study. Figure 12 comprises a screenshot of a biology lesson from the FLVS learning management system.

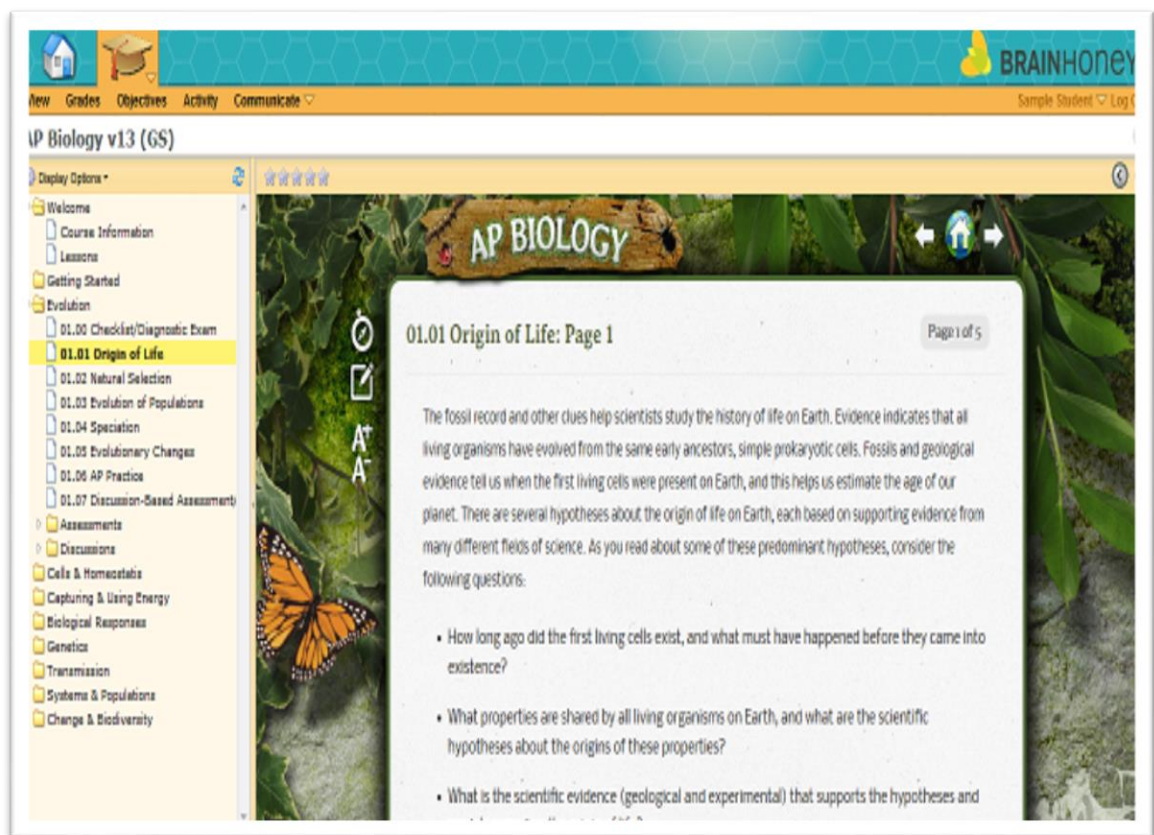


Figure 12: Screenshot of FLVS LMS

Figure 13 shows an excerpt from the Biology lesson on “the Origin of Life” as seen on the screenshot.

The Fossil records and other clues help scientist to study the history of life on earth. Evidence indicates that all living organisms have evolved from the same ancestors, simple prokaryotic cells. Fossil and geological evidence tells us when the first living cells were present on earth and this helps us estimate the age of our planets. There are several hypotheses about the origin of life on earth each based from supporting evidence from many fields of science. As you read about some of the predominant hypothesis, consider the following questions.

- 1) How long ago did the first living cells exist and what must have happened before they came into existence.
- 2) What properties are shared by living organisms on earth and what are the hypotheses of the origin of these properties.
- 3) What is the scientific evidence, (geological and experimental) that supports the hypothesis and models regarding the origin of life

Figure 13: An excerpt from the Biology lesson on “the Origin of Life”

Six science learners from the Peddys Victory Secondary School in Limbe, Cameroon, who are currently studying to write the General Certificate of Education examinations, were chosen as participants in the study. The selection of these learners was based on their interest in taking part in the study. They had never taken any online course before and had never studied using eContent but were familiar with studying with paper based content. This familiarity was used as

a base when evaluating their perception of eContent. They all had knowledge about computers and used it frequently for social networking at the local library, school ICT center or at the local internet café. To supplement their study material prior to interviewing them, the students were given access to the FLVS eContent for a month. During this period, they continued to study using textbooks and also attended regular classes during school hours. They were only required to study using the FLVS content after school. Learners were required to study the material on the Evolution of Life that was presented in the FLVS eContent and they were assessed weekly by being asked random questions that tested their knowledge of particular concepts. The researcher met with the learners four times a week and assisted them while they used the FLVS eContent. After the one-month period, the learners were interviewed and data collected for analysis using Mwanza's (2001) framework for operationalising activity theory.

The primary activity was, therefore, studying life science using eContent as depicted by the activity notation below;

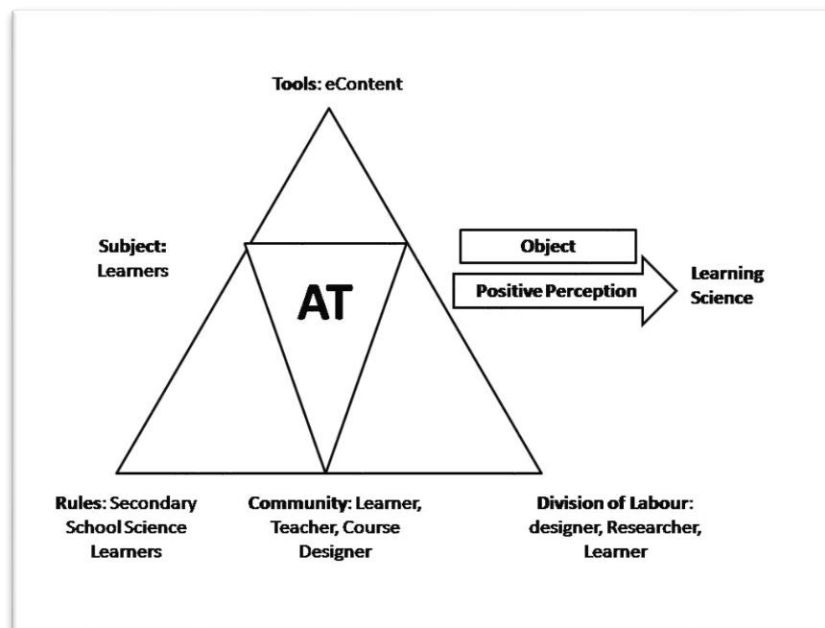


Figure 14: Activity notation for study

From the activity notation seen in Figure 14, the “rules” that were part of the study were that participants had to be secondary school science students. The “community” within the system consisted of other learners, teachers, the researcher and also the course designers. The designers were involved in designing the eContent; learners used the study material while the researcher conducted research based on interviews with the participants. Hence there was a clear “division of labour”. The research subjects, i.e. the learners, used the eContent “tool” with a motive for change, which was to learn science. However, learning can only occur if learners have a positive perception about learning with eContent. Although “perception” is a mental construct, it is used as the object of this study because a change in perception will lead to increased use of eContent and also have a pedagogical benefit to the learners.

3.5 Interview Methods

Semi-structured interviews are used in order to understand how students perceive the design of eContent for learning. Gray (2004:214) gave the following reasons why interviews are a good tool for collecting data:

- A need to attain highly personalized data;
- Opportunities for probing;
- A good return rate is important; and
- Helpful in situations where respondents are not fluent in the native language of the country, or where they have difficulties with written language.

Each interview lasted for fifteen minutes per learner. During this period, the researcher guided the student through the interview questions and recorded the interview sessions using a recorder. All six students were interviewed by the researcher in order to ensure a consistent interview technique with all the participants. Henning, van Rensburg and Smit (2004) stated that qualitative research allows the researcher to examine qualities, characteristics and activities

of a phenomenon in detail for a better understanding. The interviews were then transcribed before being analyzed using the tenets of activity theory.

3.5.1 Interviewing and interview guides (Appendix 1)

Interviews consist of talking to the research participants and collecting data from the conversations. The response from the learner being interviewed is the primary data used for the research study. Apart from collecting data from the participants, interviews assist the researcher to gain valuable knowledge about the phenomenon being studied from the participants' perspective. The aim of qualitative interviews in this study is to see the world through the eyes of the participant (Maree, 2007:87).

Semi-structured interviews were conducted (see Appendix 1) with open-ended questions used in order to probe the subject's responses adequately. The questions are framed based on the activity theoretical nodes of tools, rules and division of labour according to the following table below;

TABLE 2: MATCHING RESEARCH QUESTIONS TO ACTIVITY THEORY

Activity Theory Node	Definition of Node	Question relating to Node
Tools	Visual tools e.g. Multimedia used in eContent design	-What aspects in the design of the eContent do you like and how has this hindered or improved your understanding of science? -What do you think about studying using mobile eContent?
Rules	Explicit and implicit rules about the use of eContent including mandatory use of eContent during the study.	-How much time do you spend studying using eContent?
Division of Labour	Roles undertaken by the learners in the use of eContent	-The question about learners use of "social media when using eContent" is intended to understand the roles they play when they use eContent and how they construct

		knowledge
Community	Activities of those involved in the use of eContent which includes teachers and other learners	-Do you use social media when using eContent, what do you use it for.
Subject	The learners and their use of visuals as tools to learn science using eContent.	-Although there was no specific question addressing this, learners' answers to the question about their "preference in using paper or eContent" will give pointers as to why they may or may not like using visual tools such as multimedia (e.g. Videos) for learning science.
Object	How contextual factors affect perception including issues around historicity and use of paper based learning material.	-Do you prefer using paper content or eContent? Explain why you like your choice. -What difficulties do you have when using eContent?

In order to ensure that ethical standards were maintained throughout the research, participants were required to sign a consent form and reminded that participation in the research study was purely voluntary. Permission was also sought from the research participants so that the researcher could record the interviews in order to make the process of transcribing easier.

To ensure validity and consistency in the interview process, all the interviews were conducted by the researcher.

3.6 Validity and Ethical Issues

Validity is regarded as one of the strengths of qualitative research and is used to determine whether the findings of the research are accurate from the respondents and researcher's point of view Henning *et al* (2004). A number of precautions were taken in order to improve the validity and reliability of the study; these included pilot testing and ensuring a high level of research ethics. Apart from this, the research data was collected during the interviews by recording the participants' observations and triangulation of this data was ensured. Fielding and Fielding (1986) defined triangulation as collecting information using a variety of sources and methods. Triangulation reduces the risk that conclusions will reflect only the systematic biases and limitations of a specific source or method and allows the researcher to gain a broader and more secure understanding of the issues being investigated (Maxwell, 2005).

3.6.1 Pilot Testing of Instruments

The interview guides were pilot-tested with two students; this assisted the researcher in improving the research questions as well as correcting minor grammatical errors that could possibly affect learners' understanding of questions. Light, Singer and Willet (1990:213) stated that "No design is ever so complete that it cannot be improved by prior, small-scale exploratory study. Pilot studies are almost always worth the time and effort".

3.6.2 Research Ethics:

This research study involves human subjects, primarily constituting secondary school students. Some of these students are under-aged (under 18years) and therefore needed parental consent before they could be used as research participants. Apart from this, adult supervision was needed and the research material had to be kept confidential. Ethical principles were employed to gain the

information that could answer the research questions (Maxwell 2005:83). This was done through a process of negotiation and renegotiation of relationships between researcher and participants. As Wiess (1994) quoted in Maxwell (2005:84), stated: “What you can’t get away with in research is the failure to work with respondents as a partner in the production of useful material”. Participants were therefore made aware of the research and also guaranteed confidentiality.

The research was conducted with strict adherence to the UCT code of ethics for research which involves conducting research with:

- Scholarly integrity and excellence;
- Social sensitivity and responsibility;
- Respect for the dignity and self-esteem of the individual and for basic human rights;
- Reference to clearly specified standards of conduct and procedures ensuring proper accountability; and
- A high level of confidentiality being ensured in the research and the real names of interview participants not being revealed in the interview transcript.

3.6.3 Researchers Bias:

Miles and Huberman (1994:263) noted that qualitative conclusions have two important threats to validity. This includes selecting data that fit the researcher’s existing theory or preconceptions and selecting data that ‘stands out’ to the researcher as having relevance for the research. Before starting this study, the main hypothesis was that secondary school science students have a poor perception of the design of the Florida Virtual School (FLVS) eContent and therefore do not use the eContent optimally for effective learning. The researcher’s assumptions were that if content design took into account the

learners' context, it could lead to optimal use of eContent. With a sound knowledge of the assumptions the researcher had before conducting this study, it was possible to counter the effect of research bias. As Maxwell (2005:108) notes, understanding how a particular researcher's values and expectations influence the conduct and conclusions of the study (which may be either positive or negative), helps avoid such consequences.

3.6.4 Reactivity

Reactivity is the influence of the researcher on the setting or on the participants (Maxwell, 2005:108). The goal in this study was, however, not to eliminate the influence of the researcher, but to understand it and use it productively. Using interviews as a research method also reduced the consequences of reactivity. To this end, the researcher avoided leading questions and conducted the interview process personally. The interviewer also avoided influencing the interviewee's responses by refraining from frequent interruptions and by avoid and making suggestions during the process.

3.7 Summary of Chapter

This study is qualitative in nature as is evident from the research design, with semi-structured interviews being the main method of data collection.

Participants were selected from students currently using eContent designed by the Florida Virtual School and delivered through their Learning Management system. Data collection methods were through interviewing with the researcher taking precautions to ensure the research was carried out ethically and was valid.

Data was analyzed using activity theory, which served as the analytical framework.

The findings and analysis of this data are presented in Chapter 4.

CHAPTER 4: Analysis of Results

4.1 Introduction

The previous chapter provided a brief outline of the research design. Semi-structured interviews were used as the primary method of data collection and necessary measures were taken to ensure that the research was valid. This included:

- Ensuring that the research was undertaken ethically by seeking informed consent from the research participants;
- Obtaining permission from Florida Virtual School (FLVS) in order to conduct the research; and
- Ensuring that the research outcome was not affected by the researcher's prior conceptions about the research problems.

In this chapter, the researcher presents the data collected through interviewing secondary school science learners as they use eContent for learning. The data is presented in tabular format and includes transcripts of interviews conducted during the research. This is followed by an analysis of the data, preliminary findings, a conclusion and the chapter summary respectively. In this chapter, activity theory is also used to analyse the interview questions using Mwanza's (2001) framework.

4.2 Coding of Data

The results obtained from semi-structured interviews with students using eContent designed by FLVS are presented in this chapter. The data are coded, with codes referring to participant (P), Response from participants (R), and interview questions asked of participants (Q). This is done in order to ensure anonymity of the respondents. The data are then organized according to text genre and discursive types as shown in Table 4.3. In total, six participants were

interviewed, hence P1 to P6. Six questions were asked during interviews (Q1 to Q6) and six responses were obtained from the interview transcripts (R1 to R6). This chapter ends with a summary. The following interview questions were asked to the participants:

Q1). How much time do you spend studying using eContent?

Q2). Do you prefer using paper content or eContent? Explain why you like your choice.

Q3). What difficulties do you have when using eContent?

Q4). What aspects in the design of the eContent do you like and how has this hindered or improved your understanding of science?

Q5). Do you use social media when using eContent? What do you use it for?

Q6). What do you think about studying using mobile eContent?

Table 3: Meaning of Codes.

Codes	Meaning
P	Participant
R	Response
Q	Question

4.2 Research procedure

In conducting the research, six science learners from the Peddys Victory Secondary School in Limbe, Cameroon who are currently studying to write the General Certificate of Education examinations were chosen as participants in the study. These learners were selected based on their interest in taking part in the study and after receiving informed consent from their parents. The students were given access to the FLVS eContent for a month to supplement their study material. During this period, they continued to study using textbooks and also attended regular classes during school hours and were only required to study

using the FLVS content after school. Learners were required to study the material on the evolution of life that was presented in the FLVS eContent and they were assessed weekly through randomly asked them questions testing their knowledge of particular concepts. The researcher met with the learners four times a week and assisted them while they used the FLVS eContent. After the one-month period, the learners were interviewed and data was collected for analysis.

Table 4: Meaning of various codes in data

Code	Meaning
P1	First research participant
P2	Second research participant
P3	Third research participant
P4	Fourth research participant
P5	Fifth research participant
P6	Sixth research participant
R1	Respond from first participant
R2	Respond from Second participant
R3	Respond from third participant
R4	Respond from fourth participant
R5	Respond from fifth participant
R6	Respond from Sixth participant

4.3 Data Presentation: See Appendix 5

4.4 Analytical Framework

Data for this research was collected using interviews that were recorded then transcribed and analyzed by the researcher. All recording was done using the voice recording system of Evernote on the researcher's mobile phone. All the transcripts were read several times in order to improve the validity of the research. Analysis of the data was based on the principles of activity theory which was conceptualized by Engeström. Engeström (1996) stated that work activity systems have components which comprise:

- Individual workers and their colleagues; in this case, the learners;
- Tools and equipment which are used for work. In this research, this is eContent;
- The rules that govern how individuals participate within the activity system; and
- The purpose towards which members of the workplace community direct their activity. This often relates to the intended outcome.

In the use of activity theory relating to this study, people (learners) use external tools (e.g. eContent) to achieve their goal of learning science. In the social world there are many artifacts, which are seen not only as objects, but also as things that are embedded within culture and these have an influence on how learners perceive their surroundings. In this study, the socio-cultural settings of the learners can result in either a positive or negative perception of the learning tools (eContent). Hence, the object has cultural and/or social significance.

The activity model is shown below

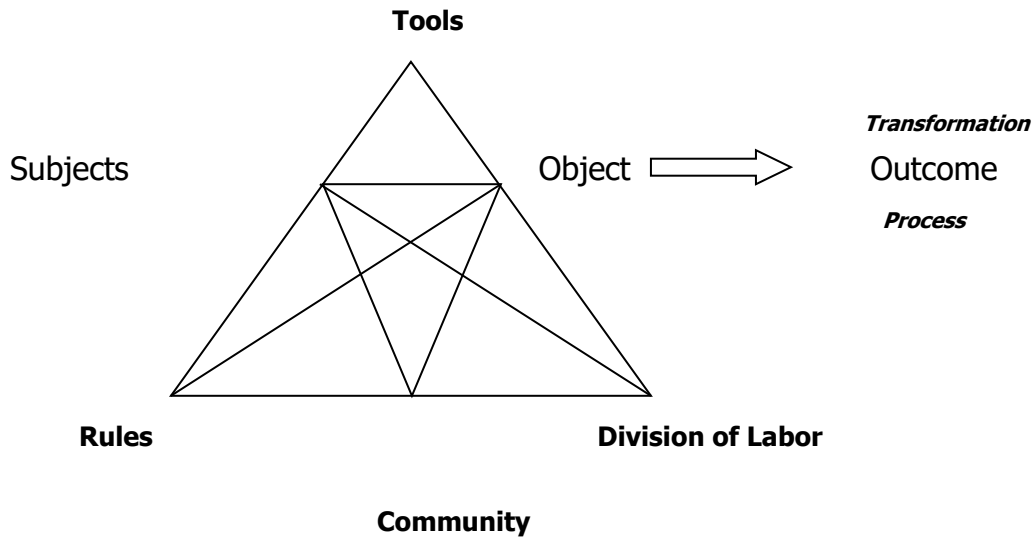


Figure 15: Activity triangle Model (Engeström, 1987).

Tools (eContent) can have either a limiting or enabling effect on learning and can be mediated in the design of the eContent by social interactions enabled by social media. Social interaction can also influence the behavior of learners who use eContent and ultimately the social structures within which learners exist i.e. their environments, tools and artifacts. These interactions could be a motive for change within the activity system. Therefore, the way learners learn and interact with one another can be mediated by the objects of this activity. Objects therefore include ambient characteristics such as ICT infrastructures and non-tangible characteristics such as perception, which is a mental construct.

The ideas of Thorndike are discussed by Vygotsky (1978) whose theory also represented the original framework of behaviorism. According to Thorndike, learning is a result of trial and error during which associations are formed

between various stimuli. Such associations become stronger or weaker when certain responses dominate others because they can lead to rewards. According to Vygotsky, Thorndike proposed that:

[. . .] learning is the acquisition of many specialized abilities for thinking about a variety of things . . . which does not alter our overall ability to focus attention but rather develops various abilities to focus attention on a variety of things. My argument is that if the socio-cultural conditions do not favor the acquisition of specialized abilities for thinking, this can lead to poor perception of learning tools and also negative learning outcome.

Mwanza (2001) proposes a six-stage framework for operationalizing AT using the activity triangle:

Stage 1 includes modelling the situation being examined.

Stage 2 includes producing an activity system for the situation being examined

Stage 3 includes decomposing the situations within the activity system. This is usually demonstrated within the activity triangle.

Stage 4 involves generating research question based on the activity triangle.

Stage 5 includes conducting a detailed analysis of the system.

Stage 6 includes interpreting the findings of the activity framework.

This research focused on the perception of secondary school students' as they used eContent.

The model of the activity theoretical situation being examined is as follows:

- **Activity of interest:** Learning of science
- **Objects:**
 1. Perception of students (non-physical attributes)
 2. ICT infrastructure (physical attributes)
- **Subjects:** Secondary school science learners.
- **Tools:** eContent
- **Rules and regulation:**

Participants must be secondary school science students accessing eContent using laptops.
- **Division of labour:**

Learners use eContent for learning whilst the researcher conducts research.
- **Community:** Learners' community
- **Desired outcomes:** Learning science.

From a study of the learners' perception of the design of eContent, a clear pedagogic outcome would be that learners are able to "learn science" as they interact with eContent, hence eContent is the "tool" in the activity notation. The "learning community" consists of secondary school science learners, teachers and also the researcher. The activity system also has a few rules and these include aspects such as "only secondary school science learners should take part in the study" , "participants are obligated to supplement their studies with eContent". Two main "objects" can influence the outcome of the activity and these are learners' perceptions(mental construct) and ICT infrastructure (physical attribute). Although the physical attribute does not form the main investigation of this study, it cannot be ignored as it has a direct impact on perception and on how learners use eContent and whether learning occurs.

The activity system for the study is presented diagrammatically below.

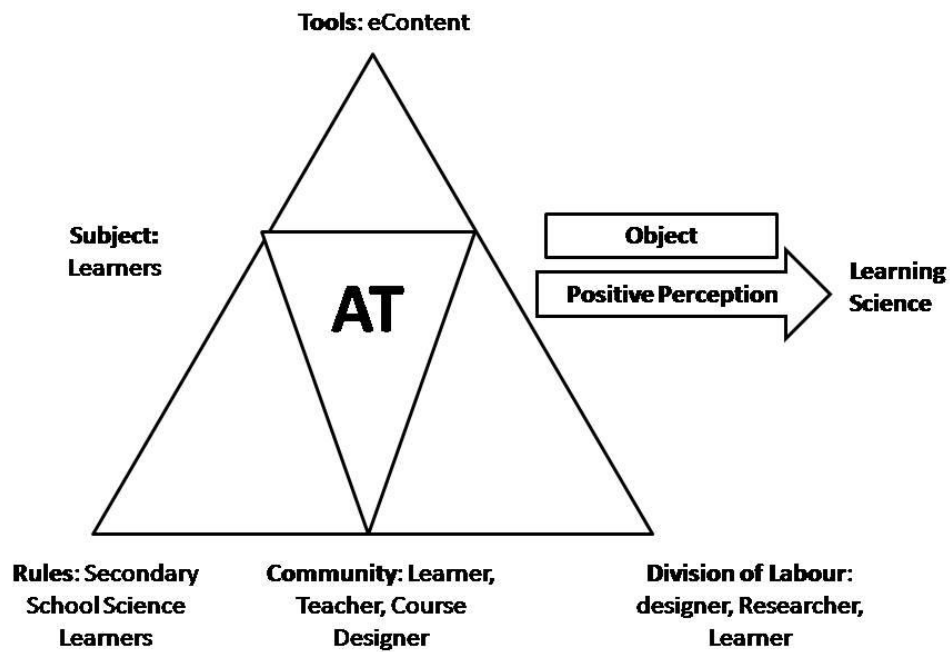


Figure 16: Activity System for Study

Further analysis of the activity system above involves decomposing the system to produce an *activity notation* which creates smaller manageable subunits. The activity notation created would be based on Mwanza's (2001) framework which is, in turn, based on three main rules;

- Actors who represent the community of the activity
- Mediators are made up of the *tools*, *rules* and *division of labour* component of the triangle.
- Object on which the activity is focused, in this case, perception.

An activity will involve an interaction of all these systems.

Table 5: Activity Notation (Adapted from Mwanza 2001)

Actors(Doers)	Mediator	Objective(Purpose)
Subjects (S)	Tools (T)	Object (O)
Subjects	Rules (R)	Object
Subjects	Division of Labour (D)	Object
Community (C)	Tools	Object
Community	Rules	Object
Community	Division of labour	Object

From the table above, “actors” interact with both “mediators” and the “object”.

Specific research questions are then generated from this activity notation which can be further analysed. The research questions are highlighted on the table below:

Table 6: Activity Notation of Research Study

Actors(Doers)	Mediators	Objective(Purpose)	Questions Generated
Science Learners	eContent	Positive Perception	How does science learners’ use of eContent improve perception?
Science Learners	ICT Infrastructure	Positive Perception	How does ICT infrastructure affect learners’ perception about learning science?
Science Learners	Social Media/mobile	Positive Perception	How does social media and mobile

	Content		content affect learners' perception about learning science?
--	---------	--	---

From the activity notation, we are able to generate research questions which serve as pointers for a review of the entire study. From this notation, further questions are triggered which will be linked to the interview responses from the participants in the study and also to the research questions the study aimed to answer. The notion of contradictions is employed when analyzing and interpreting this data. Contradictions help to focus efforts on the root causes of problems within the system.

In this study, contradictions are identified by mapping questions generated from the activity notation of this study, and the data generated during interviews.

Below is a representation of questions generated from the activity notation, related responses from interview questions and the contradictions that were identified.

Question generated from activity notation:

- 1) How does science learners' use of eContent improve perception?

Response from Interviews;

P1R4 : *"What I like is the graphic design and I like the video too....."*

P4R4: *"The videos ease my understanding of concepts..."*

Contradictions:

P6R4: *"To me it is almost the same like paper because I find it difficult to watch some videos because the connection is slow..."*

Question Generated from Activity Notation;

2) How does ICT infrastructure affect learners' perception about learning science?

Response from Interviews;

P2R2: *"I prefer using paper to electronic content because of the difficulties I have mentioned like problems with light, slow internet connection and we don't have enough money"*

P3R3: *"We always have power failure and this interrupts our internet connection..."*

Contradictions:

P5R6: *"It will be a good idea. But I think it is better if we can be able to connect the phone to our TV..."*

Question Generated from Activity notation:

3) How does social media and mobile content affect learners' perception about learning science?

Response from Interviews;

P1R6: *"I think it will be easier to use my cell phone for studying....."*

P6R5: *"Yes I use social media. Our holiday classes teacher said we can send him messages if we have problems and need help...."*

Contradictions:

P5R5: *"No, I don't use social media during studies. Our teachers said it will distract us...."*

P4R5: *"I don't yet have a Facebook account. My parents say I will only start using it when I am old enough. Maybe when I turn eighteen (18) ..."*

From the above questions and the responses given in the interviews, the use of multimedia in the design of eContent has a positive impact on the learners' perception. However, some learners still complain about difficulty in accessing this eContent and would prefer using paper based learning materials.

Bad ICT infrastructure seems to be a major influence affecting learners' perception because, despite in the advantages of Content, they are unable to access it most times.

The learners also expressed their willingness to learn using mobile content facilitated by social media. However, cultural issues might also prevent them from using these tools as they are not quite socially accepted within their learning context.

4.7 Discussions

In activity theory, a relationship exists between the subjects, in this case, secondary school science learners and the object of their activity as they interact with eContent. Their perception about the activity of learning using eContent can be greatly affected as they engage in the core activity. Although "perception" encompasses the focus of this activity, it can be affected way beyond the current activity in which the learners are engaged. As a result, there might be both intended and unintended outcomes from the current activity of learning using eContent. Due to changes in perception resulting from changing conditions within this activity system, there are unintended outcomes such as "low use of eContent" and in extreme cases "no use" of eContent. This is represented diagrammatically in the conceptual framework below.

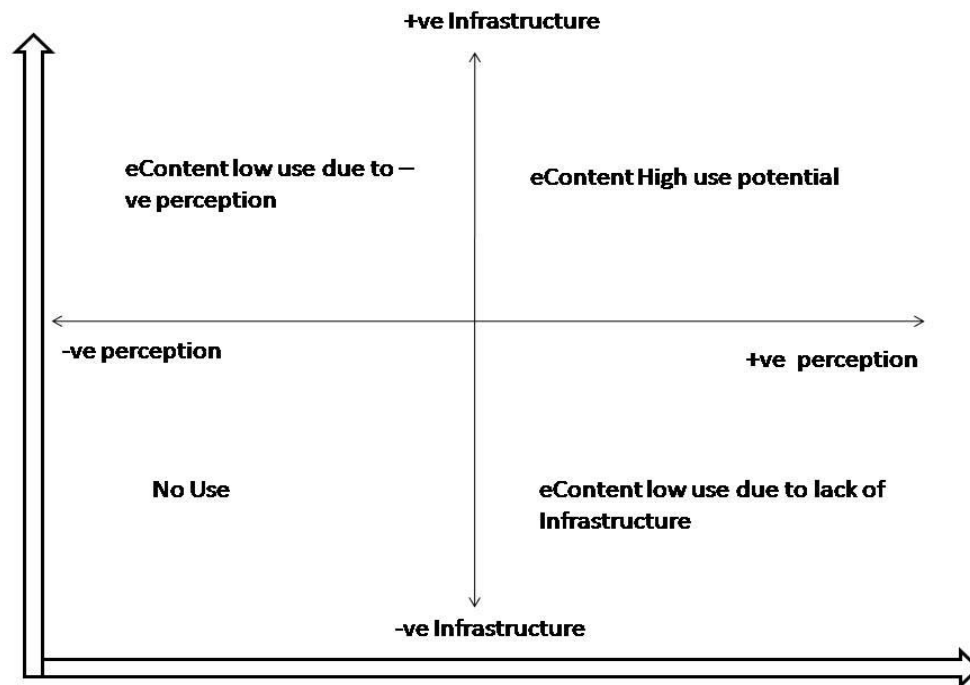


Figure 17: Conceptual framework

A good ICT infrastructure and positive perception of eContent leads to high usage whilst a good ICT infrastructure and a negative perception leads to low use of eContent. Similarly, a negative perception coupled with bad ICT infrastructure leads to no use of eContent and a positive perception with very bad ICT infrastructure causes low use of eContent. Using activity theory as an analytical framework provides insight into change in the practices of learners and how their learning becomes restructured when a new technological tool or different socio-cultural conditions become part of the learning activity. Activity theory can be relied on when studying the context of the implementation of innovations in educational technology because introducing a new technology results in conflicts or contradictions between learners' beliefs and actual practices. Contradictions have been described as "a misfit between, and with elements between, different activities, or between different developmental phases of a single activity" (Kuutti, 1996). Contradictions also emerge as

“unintentional deviations from the script which cause dis-coordination in interaction” and “deviations in the observable flow of interaction” (Engeström, Brown, Christopher & Gregory, 1991). They are disruptions (Berge & Fjuk, 2006), “problems, ruptures, breakdowns, clashes” in activities (Kuutti, 1996). They result in double binds in everyday practices when an individual receives “two messages or commands which deny each other” (Engeström, 1987). Contradictions are important, not in and of themselves, but because they can result in change and development (Engeström, 2001). Third-generation activity theory through contradictions provides a valuable insight into tensions that occur when a new technological tool becomes part of the teaching activity. AT is also a reliable means to study the context of the implementation of innovation in education, such as when new technology is introduced and conflicts occur between teachers’ beliefs and their actual practices (Lim & Hang, 2003; Russell & Schneiderheinze, 2005). In this research, the new technology that became part of the activity system of the learners is the introduction of eContent to their mode of learning. Here there is a contradiction between static content such as paper, which the students have been using, and the more mobile eContent. Issues with internet bandwidth, technophobia, the context in which learning occurs, constant load shedding and other disruptions all stand as contraindications to the use of eContent for learning.

Using activity theory, the researcher sought to understand human activities as socially situated complex phenomena that cannot be defined within a particular paradigm. Activity theory brings to light several other factors that may influence the outcome of an activity such as using eContent for teaching and learning. Through an analysis that applies activity theory, we start seeing other factors, for example tools and artefacts that exist in the environment and may negatively or positively affect a particular activity system with which the research is involved. The framework proposed by Mwanza (2001) helps us to identify the tensions within an activity system and to find out how these tensions or contradictions influence the particular activity with which the research is involved.

4.8 Summary of Chapter

In Chapter 4, the researcher first outlined the data obtained and then discussed the findings of the research that resulted from an analysis of the data using activity theory. The data were collected from interviews and by participant observation. In order to ensure that the participants' identities were kept secured, the data sources were coded using letters P (Participants), Q (Questions), and R (Response). All the responses from the interviews with participants were then presented in tabular format. The data was later analyzed using activity theory analysis by identifying contradictions that occurred within the learners' expectation of learning and the introduction of a new technology in the learning process. Also, Mwanza's (2001) framework is used to transform activity theory into practice by generating research questions which are used to identify contradictions within the activity system. In the next chapter, we will discuss conclusions and recommendations from the experiences gathered in the research study.

CHAPTER 5: Conclusion & Recommendation

5.1 Introduction

This chapter starts with a review of the purpose of the study (5.2), review of research questions (5.3) conclusions from the study (5.4) and recommendations for further research (5.5).

5.2 Review of Purpose of the Study

This study has as its primary objective an understanding of how learners' perception of eContent design affects its use. Activity theory has been used to analyze interview responses from learners currently using eContent for learning science. The activity of learning science is a complex, socially situated phenomena which cannot be defined within any particular paradigm as it involves the interaction between several components of the activity system. For learning to occur, eContent needs to interact with other components of the system to produce an object that leads to the desired learning outcome.

Findings of this study could be useful in informing course designers in African countries about the importance of considering learners' needs when designing learning content. This knowledge could enhance instructional design strategies to improve learning using eContent in developing countries in general, and Cameroon in particular. It could also reduce the dependency on eContent designed elsewhere. Furthermore, findings arising from this study could encourage education specialists, education planners and curriculum developers to align digital learning to their learners needs. A positive perception of eContent will improve how learners learn science and hence contribute in a positive way to pedagogy. Pedagogy can be viewed as an act whereby an attendant who is considered knowledgeable leads a child at school (Webb & Cox, 2004). This definition of pedagogy is, however, not reflective of 21st century learning, which can occur online where learners interact with learning content without the

'knowledgeable leader' always present. Hardman's (2007) definition of pedagogy as a structured process whereby a culturally more experienced peer or teacher uses cultural tools to mediate or guide a novice so they acquire relatively lasting changes to their behavior within a particular institutional context is an acceptable definition for this study. With this new definition of pedagogy, perception of design becomes a very important factor as the role of the teacher is more of 'mediating' than 'leading' and the learner needs to learn independently. Also, the learning situated within an institutional context which is an intrinsic aspect of 21st century pedagogy becomes increasingly important. Activity theory therefore made a good analytical framework for the analysis of interviews of participants gathered within a particular socio-cultural context, in this case secondary school science learners in Cameroon using eContent. The learners used a new technology for learning and there was a disruption in their normal learning activity as they were not familiar with using eContent.

The activity theoretical principle of contradiction was used to understand the perceptions of learners as they used eContent (Chapter 4). Contradictions helped them focus their efforts on the root causes of problems within the system. In this study, contradictions were identified by mapping questions generated from the activity notation and the data generated during interviews (Fig 4.6). The perception of eContent is affected by the design of that eContent and also by the social conditions within which the eContent was used.

During the interviews, some questions were created with the intention of understanding the learners' perception of the use of social media in the design of eContent. The interactive nature of social media and its ability to allow the learners to form learning communities in and out of school allows them to build such communities and this could potentially improve their perception of eContent. However, the interpretations of the interview questions using activity theory showed that the learners, the teacher and even parents held differing beliefs about technology and these cultural differences influenced how learners

perceived eContent (Fig 4.6). Cultural differences on the perceived role of social media in learning prevented learners' access to this mode of communication as some parents believed social media 'distracts' learners rather than supports learning. Based on these observations, a new conceptual framework was developed and it is represented below;

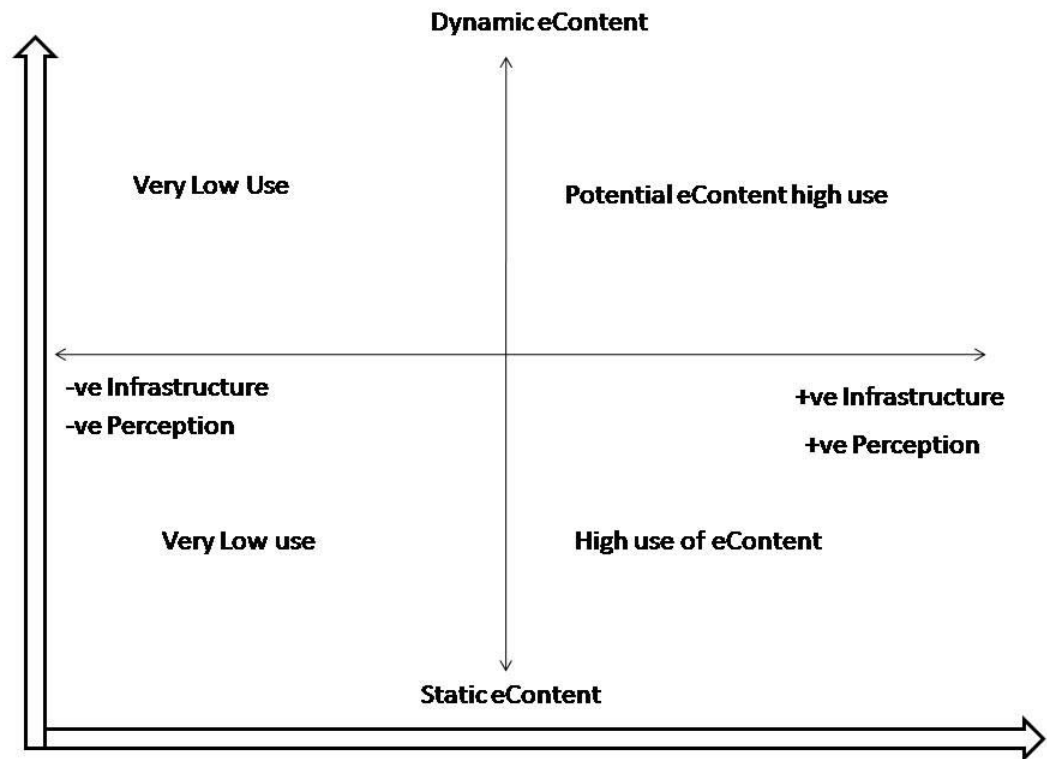


Figure 18: New Framework of Study

From the above diagrammatic representation of the updated conceptual framework, there seems to be an insignificant effect on how eContent is used based on how dynamic or static it is. Perception and ICT infrastructure tend to be the major drivers in the use of eContent for learning science. There will be a high use of eContent even if it is static, provided there is a good ICT infrastructure and a positive perception. Due to cultural differences on how social media is perceived within the schools and homes of learners, there could be a potentially

high use of interactive eContent in a situation where there is good ICT infrastructure and an overall positive perception of eContent. This, however, would need some form of awareness to be created with parents and teachers as to how social media could be incorporated into learning with eContent. Generally, within the activity system, there is very low use of eContent as a tool for learning. As the rules within the activity system require that learners have access to computers in order to fully participate in the learning process, low ICT infrastructure limits learners from fully participating in the learning process.

5.3 Review of Research Questions

This study investigated how perception of eContent affects use within secondary school science learners. The results could help potential designers of eContent in Cameroonian secondary schools better understand and create designs that improve perception and increase use.

The study was guided by four research questions: one primary research question and three secondary research questions. The primary research question is as follows:

- What are the social conditions that influence students' perceptions of eContent? In what way does student perception of eContent affect its use?

The primary research question has a sub question as indicated above.

From the literature review illustrating how perception affects use (See section 2.4.1), a poor perception of eContent can lead to low use while good perception can increase its use. This research also shows that some contextual factors might affect the use of eContent which could hinder its use in learning science. Social conditions, including ICT infrastructure and the way social media is perceived by teachers and parents, has an effect on how eContent is used. This

research established a basis through which the design of eContent could help to improve perception using activity theory as a framework. The interview responses showed that some of the social conditions that greatly affected learners' perception of eContent included poor internet connectivity, lack of 24-hour access to the computer laboratory, difficulty in accessing eContent due to lack of computer infrastructure and difficulty in viewing multimedia material used in the design of eContent because the videos or images did not load properly.

From the 'activity theoretical principle of contradictions', it is seen that tensions and disturbances arise within the activity system between different interacting components and these contradictions can be a source of either trouble or innovation within the system (Engeström, 2008). Considering that the users of eContent are millennials, there is a view that these students are comfortable using technology for learning (Prensky, 2001a). This, however, comes into question due mainly to the fact that there is multi-voicedness in the activity system. Learners have multiple perspectives, interests and traditions and these can be a source of trouble and transformation in the system because members in this activity system carry diverse histories from different contexts. The activity system itself carries multiple layers and strands of history engraved in its artefacts, rules and conventions (Engeström, 2001:136). These multiple perspectives lead to users suggesting the use of mobile eContent which could be accessed from their phones without them having to go to cyber cafes to study using eContent. While social media is seen by some parents as 'distracting', it is often regarded as an innovative way in which eContent may be designed to increase the formation of online learning communities. The perception of eContent design could be greatly improved by introducing mobile eContent and also by educating parents about the benefits of social media in learning.

The second research question is as follows;

“To what extent does eContent designed outside Cameroon mediate the learning of secondary school science in Cameroon?”

The literature review (2.6) shows that multimedia material has the potential to improve perception of eContent and also improve its use. By applying the research question, the researcher set out to investigate how content designed for the Florida Virtual School was perceived by secondary school science students in Cameroon. To a greater extent, this question also investigates how eContent designed for learners in one context can be successfully adopted and utilized by learners in another context. This principle of design and perception was highlighted by (Kuutti, 1996:26) when he stated that the history of an activity can help us understand its problems as well as its potential because parts of the older phases of the activity often stay embedded in that activity as they develop. In this case, i.e. the activities of the designers of eContent, their conception of design is reflected in the eContent now used by the learners in Cameroon and this can affect how these learners perceive eContent. From the interviews (P1R1), and subsequent analysis of data, the learners' perception of eContent is affected positively by the use of multimedia material in design; however, this multimedia material can also lead to poor perception of design when internet bandwidth (P3R3) prevents learners from accessing eContent.

Therefore, good quality multimedia content such as videos which can be appropriate for use in eContent design in the United States might be inappropriate for use by secondary school science students in Cameroon.

The third research question is as follows:

- What are the contradictions encountered in the use of static eContent and interactive eContent?

Contradictions can result in transformation and tension within the activity system. In this research, there is a contradiction in the use of eContent and paper content for learning. Most of the learners interviewed indicated that they liked the multimedia nature of eContent (P2R2, P4R2). eContent use also provided a means for learners to communicate with each other using social media (P1R5) and this interaction contributed to an improvement in the way learners perceive the design of eContent. Contradictions can lead to unintended outcomes which lead to transformation in the system. There needs to be further development of the ICT infrastructure for learners to move from the use of a paper based environment to an electronic environment. During the interviews (P6R3), learners stated the difficulty they had accessing electronic content due to the lack of good internet connectivity. Without development of a fast ICT infrastructure, learners' perceptions of eContent will remain negative and paper based learning material will still be contextually relevant.

The last research question is as follows;

- How do learners perceive design aspects such as the role of social media in engaging with Content?

From the interviews, it became apparent that most learners already use social media to communicate with friends (P1R5, P2R5). Some learners don't use social media yet due to restrictions imposed by their parents and teachers (P4R5, P5R5). The use of social media in the design of eContent can, however, create a positive perception of use.

5.4 Conclusion

Although the use of eContent for learning is still at the early stages in Cameroon, it presents an alternative way through which learning material can be presented to learners. However, it is important for learners in developing nations to have a positive perception of eContent in order to promote its use. Apart from design

related factors, ICT infrastructure also has an effect on how learners perceive the design of eContent. These factors have been grouped into two categories below.

5.4.1 Design Factors

As the name suggests, design factors relate to technologies and media used in the design of eContent. These include the use of social media and the use of multimedia in design. Social media incorporated into the design tends to give students a positive perception of design. During the interviews, learners had difficulty playing videos; consequently, multimedia materials such as videos could cause a negative perception of eContent in resource constrained environments. Images and the overall graphics afforded by eContent had a positive impact on the learners' perception of design.

5.4.2 Socio-technical Factors

Socio-technical factors which are not design-related can also affect how learners perceive the design of eContent. This includes factors such as bad internet connectivity, difficulty in using eContent due to internet speed, difficulty in accessing the internet and the availability of a basic computer infrastructure. Improving these baseline factors can greatly improve the perception of the design of eContent by secondary school science learners and also improve its use.

5.5 Recommendations for further research

The study focused specifically on how learners' perception of eContent affects use, specifically in the Cameroonian context.

There are several suggestions for further research:

- In this study six learners used the FLVS eContent and their perceptions were gathered through interviews to gauge their perception of this eContent. These learners were individually provided with a demo account

to access the content and were able to study using this content for a month prior to being interviewed. As such, learners were not able to use this content for an extended period of time. An interesting area of research would be to gauge the perception of learners who use eContent as the exclusive medium of instruction;

- Further research can also be conducted on institutional capacity to support the use of eContent for teaching in secondary schools;
- There is also the research area where students' perception of eContent designed in Cameroon can be studied;
- The findings of the study have also brought about an important factor that can also greatly influence learners' perception of the design of eContent; this is the availability of ICT infrastructure that supports the use of such online and/or offline content. An area for further research could also be an investigation into the integration of technology to support the use of eContent in schools in developing countries; and
- Further research into learners' use of mobile eContent, especially in developing communities, would be relevant as well as the means of using social media to support learning with eContent.

5.6 Recommendation for practice

Emanating from this study is the following practice recommendation for secondary schools in Cameroon wishing to implement the use of eContent for learning in their schools:

- Learners' use of eContent can be greatly influenced by their perception of how it is designed. It is important for learners to have a positive perception of any study medium, be it the teachers or even the study material to which they have access. However, in the use of eContent, poor infrastructure and internet connectivity also greatly affect the quality of

learning. Several other factors apart from design have to be considered when implementing such learning structures in secondary schools. This involves putting into place facilities that would greatly facilitate the activity of learning and also facilitate how members of the learning community interact with one another. If paper is replaced by the rich interactive multimedia afforded by eContent, the ease of use of paper for studying has to be replicated when learners study using multimedia material. In general, this would involve putting into place the appropriate ICT infrastructure necessary to adopt the use of computers and the internet for learning science in Cameroonian secondary schools.

- In Africa paper based learning material will still be used, especially where proper infrastructure is a challenge. However, there is a need for the use of eContent where pedagogy doesn't have to be exclusively eContent. It is also possible to use eContent together with paper-based learning material.

Finally:

Although Information Communications Technology has the potential to make educational material accessible online to science learners, the actual use of this content might be negatively affected if learners have a poor perception of accessing educational material electronically. Although several contextual factors, such as bad internet connectivity, power unavailability and lack of ICT equipment might be a cause, other factors such as the design of study material can have a significant effect on perception.

References

Aedo, I., & Landoni, M., 2003. Digital contents for education. *Educational Technology and Society*, 6 (4), 6-7.

ADL, 2005. Advanced Distributed Learning, viewed May 29, 2016 from <http://www.adlnet.org/>.

Aloraini, S., 2012. The impact of using multimedia on students' academic achievement in the college of education at King Saud University. *Journal of King Saud University, Languages and Translation* (24), 75-82

Attewell, J., 2005. Mobile technologies and learning, A technology update and m-learning project summary.

Boag-Munroe, G., 2008. Investigating teachers' language use using activity theory concepts and critical discourse analysis. *Paper presented at the 'Sociocultural Perspectives on Teacher Education and Development' conference*, Department of Education, University of Oxford.

Bannan-Ritland, B. 2003. The Role of Design in Research, The Integrative Learning Design Framework. *Educational Researcher*. 32 (1), 21–24.

Bhagat, K., Wu, Y., & Chang, C., 2016. Development and Validation of the Perception of Students towards Online Learning (POSTOL). *Educational Technology & Society*, 19 (1), 350–359.

Cassidy, E., Colmenares, A., Jones, G., Manolovitz., T., Shen, L., & Vieira, S., 2014. Higher Education and Emerging Technologies, Shifting Trends in Student Usage. *The Journal of Academic Librarianship* (40), 124–133.

Cher Ping Lim., 2002. A theoretical framework for the study of ICT in Schools, A proposal. *British journal of educational technology*, 4(33), 411-421.

Chih-Hsiung .,2002. ELearning Communities. *The Quarterly Review of Distance Education*. 3(2), 207-218.

Chuttur M.Y., 2009. Overview of the Technology Acceptance Model: Origins, Developments and Future Directions', Indiana University, USA. Sprouts. *Working Papers on Information Systems*, 9(37).

Clark, E., 2001. A summary of disagreements with the "mere vehicles" argument, in R. E. Clark (ed.). *Learning from media: Arguments, analysis, and evidence*, Information Age Publishing Inc., Greenwich, CT. pp. 125-136.

Collins, A. & Brown, J.S., 1988. The computer as a tool for learning through reflection, in H. Mandal & A. Lesgold, F., (eds.). *Learning issues for intelligent tutoring systems* (pp. 1-18). Springer-Verlag, New York. pp. 1-18.

Conole. G, Laat, M, Dillon. T.& Darby, J., 2008. Disruptive technologies, Pedagogical innovation, what's new? Findings from an in-depth study of students' use and perception of technology. *Computers & Education*. 50(2008), 511-524.

Conole, G., 2011. Social exclusion or inclusion in a Web 2.0 world. *Keynote presented at DEHub Summit, Education 2011 to 2021: Global challenges and perspectives of blended and distance learning*, Sydney.

CSCW Companion, 2014. Proceedings of the companion publication of the 17th ACM conference on Computer supported cooperative work & social computing, pp.327-330.

Davis, F., 1985. A technology acceptance model for empirically testing new end-user information systems: theory and results. *Unpublished Doctoral Dissertation, MIT Sloan School of Management, Cambridge, MA*.

Davies, S., Dean, L. & Ball, N., 2013. Flipping the classroom and instructional technology integration in a college-level information systems spreadsheet course. *Educational Technology Research and Development*, (61), 563-580.

Dede, C., Nelson, B., Ketelhut, J., Clarke, J. & Bowman, C., 2004. Design-based Strategies for studying situated learning in multi-user virtual environment. *Proceedings of the 6th international conference on learning sciences*. Harvard University, Cambridge.

DeLone, W. H., & McLean, E. R., 2003. The DeLone and McLean Model of Information Systems Success: A Ten-Year Update. *Journal of Management Information Systems*, 19 (4), 9–30.

Dexter, L.A., 1970. Elite and specialized interviewing, *Northwestern University Press*, Evanston, IL.

Diaz, V., 2010. Web 2.0 and emerging technologies in online learning. *New Directions for Community Colleges*, Wiley Periodicals, Inc. (150).

Dodd, J., 2015. Designing eLearning Courses Using LEML, Professional development offered at the University of Central Oklahoma.

Duffy, M. & Cunningham, J., 1996. Constructivism, Implications for the design and delivery of instruction, in D. H. Jonassen (ed.). *Handbook of research for educational communications and technology*, Simon & Schuster Macmillan, New York, pp. 170-198.

Draper, W., 1998. Niche-based success in CAL. *Computers and Education*. Vol. 30(1/2), 5-8.

Engeström, Y., 1987. Learning by expanding: An activity-theoretical approach to developmental research. *Oriente-Konsultit*, Helsinki.

Engeström, Y., 1999. Activity theory and individual and social transformation, in *Perspectives on activity theory*, Y. Engeström, R. Miettinen, and R.-L. Punamäki (eds). Cambridge University Press, Cambridge.

Engeström, Y., Brown, C., Christopher, L. C. & Gregory, J., 1991. Coordination, cooperation and communication in the courts', Expansive transitions in legal work. *The Quarterly Newsletter of the Laboratory of Comparative Human Cognition*, 13(4), 88-97.

Engeström, Y., 2000. Activity theory as a framework for analyzing and redesigning work. *Ergonomics* 43 (7), 960–74.

Engeström, Y., 2001. Expansive learning at work: Towards an activity theoretical reconceptualization. *Journal of Education and Work* (14), 133–156.

Fairclough, N., 1989. Language and Power. *Longman*, London.

Fielding, N., & Fielding, J., 1986. Linking data, *Sage*, Beverly Hills, CA.

Foot, A., 2014. Cultural-Historical Activity Theory: Exploring a Theory to Inform Practice and Research. *Journal of Human Behavior in the Social Environment*, (24), 329–347.

Foot, K. (2015). Using Cultural-Historical Activity Theory to Analyze Social Service Practices Evolving from the Norwegian HUSK Projects. *Journal of Evidence-Informed Social Work*, Vol 12:112–123.

Gray, D. E. 2004. Doing Research in the Real World. *SAGE Publications*, London.

Hardman, J., 2007. Towards a methodology for using activity theory to explicate the pedagogical object in a primary school mathematics classroom. *Outlines*, pp.53–69.

Hatakka, M., 2009. Build it and they will come? – Inhibiting factors for reuse of open content in developing countries. *The Electronic Journal on Information Systems in Developing Countries*, 37(5), 1-16.

Haythornthwaite, C., 2007. Digital divide and eLearning. *The SAGE handbook of eLearning research*, SAGE publications.

Herrington, J. & Oliver, R., 2000. An Instructional Design Framework for Authentic Learning Environments. *ETR & D*. Vol. 48(3).

Herrington, J., Reeves, T. & Oliver, R., 2010. A guide to authentic e-learning. *Routledge*, New York.

Hettinga, M., 1998. Towards a theoretical foundation of EVOLVE. Report of an inventory of theories relevant for a conceptual model of evolving use of groupware. *Telematica Instituut*, pp. 1-43.

Henning, E., Van Rensburg, W & Smit, B., 2004. Finding your way in qualitative research, *Van Schaik Publishers*, Pretoria.

Hodgings, W. & Duval, E., 2002. IEEE LTSC Learning Object Meta-data LOM. 1484.12.1 VI Final Draft, retrieved March 14, 2014 from <http://ltsc.ieee.org/wg12/files/>.

Horton, W., 2011. *E-learning by design*, San Francisco, Pfeiffer.CA.

Hosam, A., Hassan, S & Fahed, Z., 2015. The effect of content representation design principles on users' intuitive beliefs and use of e-learning systems. *Interactive Learning Environments*.

Hoyle, R., Harris, M. & Judd, C., 2002. *Research methods in social relations*. Thomson learning, London.

Hung, M., Chou, C., Chen, H. & Own, Y., 2010. Learner readiness for online learning: Scale development and student perceptions. *Computers & Education*, 55(3), 1080–1090. doi:10.1016/j.compedu.2010.05.004

Hui-Yin, H., Shiang-Kwei, W. & Linda C., 2008. Using audio blogs to assist English-language learning, An investigation into student perception. *Computer Assisted Language Learning*. 21(2), 181-198.

Judd, T. & Kennedy, G., 2010. A five-year study of on-campus Internet use by undergraduate biomedical students. *Computers and Education*, 55 (4), 1564–1571. doi:10.1016/j.compedu.2010.06.022.

Kozma, R., 1991. Learning with media. *Review of Educational Research*, 61(2), 179-211.

Kregor, G., Breslin, M. & Fountain, W., 2012. Experience and beliefs of technology users at an Australian university: keys to maximizing e-learning potential. *Australasian Journal of Educational Technology*, 28(8), 1382–1404.

Kuutti, K., 1996. Activity theory as a potential framework for human-computer interaction research, in B. A. Nardi (ed.), *Context and Consciousness: Activity Theory and Human-Computer Interaction*. MIT Press, Cambridge, MA. pp. 17-44.

Larson, C. & Murray, E., 2008. Open Educational Resources for Blended Learning in High Schools, Overcoming Impediments in Developing Countries. *Journal for Asynchronous Learning Networks*, (12), 85-103.

Laura, D., 2012. Hidden Levels of Internet. *Information Communication & Society*. 15(5), 720-738.

Leont'ev, A.N., 1978. *Activity, Consciousness, and Personality*. Prentice-Hall, Englewood Cliffs, NJ.

Light, J., Singer, J. & Willet, J., 1999. *By design: Conducting research on higher education*, Harvard University Press, Cambridge, MA.

Lim, C. & Hang, D., 2002. An activity theory approach to research of ICT integration in Singapore schools. *Computers & Education*, 41(1),49-63.

Lowerison, G. & Cote, R., 2007. Revisiting learning theory for e-learning, *The e-learning handbook*, Past Promises, Present Challenges, Pfeiffer.

Maree, K. (ed.), 2007. *First steps in research*, Van Schaik Publishers, Pretoria.

Maxwell, A., 2005. *Qualitative Research Design, An interpretive approach*, *Advanced Social Science Methods Series*, Vol: 41. Sage Publications, USA.

Mayer, E., 2004. Designing Multimedia Technology that supports Human learning, in *The Design of Instruction and Evaluation: affordances of using Media and Technology*, *Lawrence Erlbaum Associates*, New Jersey.

Mbangwana, M.A. 2008. Introduction of ICT in Schools and Classrooms in Cameroon, in K. Toure, T.M.S. Tchombe, & T. Karsenti (eds.). *ICT and Changing Mindsets in Education*, Bamenda, Cameroon: Langaa; Bamako, Mali: ERNWACA / ROCARE.

Miles, B. & Huberman, M., 1994. *Qualitative data analyses, An expanded sourcebook* (2nd Ed.), Sage, Thousand Oaks, CA.

Morf, E. & Weber, G., 2000. Psychology and the Bridging Potential of A. N. Leont'ev's Activity Theory. *Canadian Psychology*, May (41), 81-93.

Muilenberg, Y. & Berge, L., 2005. Student barriers to online learning: A factor analytic study. *Distance Education*, 26(1), 29-48.

Mwanza, D., 2001. Where Theory meets Practice, A Case for an Activity Theory-based Methodology to guide Computer System Design. Proceedings of INTERACT 2001: Eighth IFIP TC 13 *Conference on Human-Computer Interaction*, 9-13 July 2001, Tokyo, Japan.

Ngajie, B & Ngo-Mback, M., 2016. Integration of ICTs into the curriculum of Cameroon primary and secondary schools: A review of current status, barriers and proposed strategies for effective integration. *International Journal of Education and Development using Information and Communication Technology (IJEDICT)*, 2016, 12 (1), 89-106.

Nichols, M., 2003, 'A theory for eLearning', *Educational Technology & Society*. 6(2), 1-10.

Nkweni N. M., 2015. Mastery of Active and Shared Learning Processes for Techno-Pedagogy (MASLEPT): A Model for Teacher Professional Development on Technology Integration. *Creative Education*, 6, 32-45.

Nussbaumer, D. (2012). An overview of cultural historical activity theory (CHAT) use in classroom research 2000 to 2009. *Educational Review*, Vol. 64, No 1, 37-55.

Olson, D.R., 2004. The triumph of hope over experience in the search for "What works", A response to Slavin. *Educational Researcher*, (33), 24-26.

Park, I. & Hannafin, M.J., 1993. Empirically-based guidelines for the design of interactive multimedia. *Educational Technology Research and Development*, 41(3), 63-85.

Patten, B., Arnedillo, I. & Tangney, B., 2005. Designing collaborative, constructionist and contextual applications for handheld devices. *Computers & Education*. (46), 294-308.

Petter, S., DeLone, W., & McLean, E., 2008. Measuring information systems success: models, dimensions, measures, and interrelationships. *European Journal of Information Systems*, 17 (3), 236-263.

Phillips, A., McNaught, C. & Kennedy, E., 2011. *Evaluating e-learning: Guiding research and practice*, Routledge, New York & London.

Prenkys, M., 2001a. Digital natives, digital immigrants. *On the Horizon*, 9(5), 1-6.

Raab, R., Ellis, W. & Abdon, R., 2001. Multi-sectoral partnerships in e-learning: A potential force for improved human capital development in the Asia Pacific. *The Internet and Higher Education*, 4(3), 217-229.

Reeves, T.C., 1993a. Evaluating interactive multimedia', in D.M. Gayeski (ed.), *Multimedia for learning, Development, application, evaluation*, Educational Technology Publications. Englewood Cliffs, pp.97-112.

Russell, L. & Schneiderheinze, A., 2005. Understanding innovation in education using activity theory. *Educational Technology & Society*, 8(1), 38-53.

Salomon, G., 1993. *On the nature of pedagogic computer tools, Computers as cognitive tools*. Lawrence Erlbaum Association, New Jersey.

Sambrook, S., 2001. Factors influencing learners' perceptions of the quality of computer based learning materials. *Journal of European Industrial Training*, 25:(2/3/4),157-167.

Sandoval, A. & Bell, P., 2004. Design-based Research Methods for Studying Learning in Context: Introduction. *Educational Psychologist*. 39(4), 199-201.

SATELLIE, 2005. *Handhelds for health*. SATELLIIFE'S experiences in Africa and Asia.

- Seaman, J. & Tinti-Kane, H., 2013. *Social media for teaching and learning*. Pearson Learning Solutions and Babson Survey Research Group, Boston, MA.
- Selwyn, N., 2012. *Social media in higher education*, Routledge, London, UK.
- Seels, B. & Glasgow, Z., 1998. *Making instructional design decisions* (2d Ed.), Merrill, Upper Saddle River, NJ.
- Siemens, G. & Tittenberger, P., 2009. *Handbook of Emerging Technologies for learning*. University of Manitoba.
- Stoney, J., & Wild, M., 1998. Motivation and interface design: Maximizing learning opportunities. *Journal of Computer Assisted Learning*, 14, 40-50.
- Suraya, H., Jenny, W., Sherah, K. & Shanton, C., 2014. Understanding students' perceptions of the benefits of online social networking use for teaching and learning. *Internet and Higher Education* 26 (2015), 1–9.
- Thompson, N., 2001. Why ID? The Benefits of Instructional Design Model. *Teaching with Technology Today*. 7(6), February 15, 2001.
- Toomela, A., 2000. Activity theory is a dead end for cultural psychology. *Culture and Psychology*. (6), 353-364.
- Unwin, T., 2005. Towards a Framework for the Use of ICT in Teacher Training in Africa. *Open Learning*, (20), 113-130.
- UNESCO, 2012. Personalized learning, a new ICT Enabled Education approach. *IITE policy brief*, March 2012.
- Van Oers, B. 2001. Educational forms of initiation in mathematical culture. *Educational Studies in Mathematics*. 46, no. 1–3: 59–85.

Vygotsky ,L.S. (1987). Thinking and Speech. In R.W. Rieber, & A.S. Carton (Eds) The collected works of L.S. Vygotsky, Vol. (4) *The history and development of higher mental functions* (N. Minick, Trans.). New York: Plenum Press.

Webb, M. & Cox, M., 2004. A review of pedagogy related to information and communications technology. *Technology, Pedagogy and Education*, 13(3), 235–286.

W3C, 2004. Web Content Accessibility Guidelines 2.0, W3C Recommendations. *Working Draft 29, November 2004, viewed May 27, 2016 from <http://www.w3.org/TR/WCAG20/#overview-design-principles>.*

Wright, C. R., 2011. Developing and reviewing online courses: Items for consideration. *Association of Learning Technologies*, Vol 25.

Yang, S. J. H., 2006. Context Aware Ubiquitous Learning Environments for Peer-to-Peer Collaborative Learning. *Educational Technology & Society*. 9(1), 188-201.

Zhu, E., McKnight, R. & Edwards, N., 2009. *Principles of online design*. Fort Myers, FL: Florida Gulf Coast University. Viewed January 10, 2015 from <http://www.fgcu.edu/onlinedesign/index.html>

Appendix 1:

Interview Guide for learners Using FLVS eContent

Research Questions:

1. What are the social conditions that influence students' perceptions of electronic content?
 - a) In what way does student perception of eContent affect its use?

The secondary research questions are as follows:

2. To what extent does eContent designed outside Cameroon mediate the learning of secondary school Science in Cameroon?"
3. What are the contradictions encountered in the use of static eContent and interactive eContent?
4. How do learners perceive design aspects such as the role of social media in engaging with Content?

Research Topic:

Secondary School Students' Perceptions of eContent Design: An Activity Theory Perspective

Personal details :(Not to be disclosed)

1. Gender:

2. Age:

Interview Questions:

Q1). How much time do you spend studying using eContent?

Q2). Do you prefer using paper content or eContent? Explain why you like your choice.

Q3). What difficulties do you have when using eContent?

Q4). What aspects in the design of the eContent do you like and how has this hindered or improved your understanding of science?

Q5). Do you use social media when using eContent, what do you use it for?

Q6). What do you think about studying using mobile eContent?

APPENDIX 2

CONSENT FORM LEARNERS or GUARDIAN

Kinsley Ndenge,
Faculty of Education,
Centre for Educational Technology,
University of Cape Town, South Africa.

TITLE OF STUDY: Secondary School Students' Perceptions of eContent Design:
An Activity Theory Perspective

Researcher: Kinsley Ndenge, M.Ed. (ICTs), University of Cape Town. TEL:
+237-72-505-392 email: ndnkin001@myuct.ac.za.

Information about Study: The research aims to explain how secondary school science students in Cameroon perceive the design of eContent used for learning.

As a research participant/Guardian, all responses provided with regard to this research are **CONFIDENTIAL** and **ANONYMOUS**.

Participation in this research is voluntary and you may decide not to participate in the research. However, the researcher will be grateful if you assist by participating in the study.

Findings in this research will be made available to you upon request.

If you decide to participate in this study, please indicate by signing the below.

Name.....

Signature.....

Date.....

Researchers Signature.....

Supervisors Signature.....

APPENDIX 3,

Research Request.

Kinsley Ndenge,
Faculty of Education,
Centre for Educational Technology,
University of Cape Town, South Africa

Dear Sir/Madam:

Formal Request to carry out research Using FLVS eContent

My name is Kinsley Ndenge and I am the Founder/ Director of the African Centre for ICTs in Education and development, located in Cameroon. I am also a Masters student at the University of Cape Town, South Africa.

As part of the requirements for an M.Ed. ICTs in Education, I would like to seek your permission to carry out my research using eContent designed by FLVS.

The research aims to explain how secondary school science students' in Cameroon perceive the design of eContent for learning. As such, students would be required to use your content for learning and they would later be interviewed by the researcher in order to give an in-depth understanding of how they feel about using the content, how they compare eContent to paper content, What they feel about the design of the content and features they what they would like to be added to the design in order to make their learning experience better.

This study would be carried out with a high degree of CONFIDENTIALITY and ANONYMITY.

The findings of this study would be made available to your institution.

Thank you for your consideration.

Yours sincerely

Kinsley Ndenge, ndengekinsley@gmail.com, Phone: +237-72-505-392.

Supervisor Signature:

Appendix 4:

Transcripts of Interviews

	<i>R1</i>	<i>R2</i>	<i>R3</i>	<i>R4</i>	<i>R5</i>	<i>R6</i>
P1	Actually, I spend about three hours using electronic content each day.	I use both but I will prefer electronic content because I think it is more explicit due to the graphic presentation and the use of some videos which assist in understanding.	We usually have slow internet connection and at times it is difficult to login. It also takes a lot of time to navigate through the pages. Also, the topics in the FLVS electronic content are not the same as that given by our teacher.	What I like is the graphic design and I like the video too because they are live, it helps you to see what you are studying. It's more like practical and it leads to better understanding.	I use Facebook when chatting with my friends but I don't use it when studying.	I think it will be easier to use my cell phone for studying because it is difficult for me to use internet at the cyber café sometimes.

<p>P2</p>	<p>I don't usually spend a lot of time using electronic content because we don't have adequate facilities like laptops and fast connection that can facilitate our internet connection, so I spend very little time on the internet. I only usually access electronic content at the cyber café because I don't have internet connection at home. Even at the cyber café, it's difficult because we need to pay in order to access content online. This is expensive for us; also power failure</p>	<p>I prefer using paper to electronic content because of the difficulties I have mentioned like problems with light, slow internet connection and we don't have enough money to use at the cyber café and also to purchase laptops. With 1000cfa, I can get a text book to use whereas if I had to go to the internet café, this money won't be enough.</p>	<p>We also lack the basic training to study online courses. We need to be updated so we can know how this content actually works.</p>	<p>I love the way the graphics are done.</p>	<p>The FLVS notes don't have any social media. So I use Facebook to chat with my friends and also to see their status updates.</p>	<p>I would like to have a smart phone so that I can use the internet on my phone and even check my Facebook. If I can be able to study using my phone it would be better.</p>
------------------	---	---	---	--	--	---

	<p>interrupts the time I have for accessing electronic content because when I am studying, electricity is cut off.</p>					
P3	<p>I can be on the internet at least four hours a day but I can spend extra time at home if I have internet access.</p>	<p>I prefer accessing my content online because it's less strenuous but the problem is I am not that versed in searching the LMS and getting exactly what I need.</p>	<p>We always have power failure and this interrupts our internet connection. There are other times when the internet connection is really slow and this makes learning boring and</p>	<p>I like the video and the links because it makes it easier for me to navigate through the learning material.</p>	<p>I don't use social media yet. But I will open a Facebook account soon.</p>	<p>I don't have a phone yet. But I think using a mobile phone for studying would be very convenient.</p>

			cumbersome.			
P4	Sometimes two hours at most four hours a day. This is mostly on my personal time at the cyber café because I can time myself on how long I have to study with the money I have. In school we are limited on the time we have to spend in the computer laboratory.	I prefer using paper content firstly because there is a lot of a power shortage so it's not very reliable for me to use electronic content, so I prefer going back to paper.	I don't own my personal laptop or I have to go to the cyber café. Sometimes when you go there, it is very crowded and also there might be abrupt power failure.	The videos ease my understanding of concepts and also make studying more interesting.	I don't yet have a Facebook account. My parents say I will only start using it when I am old enough. Maybe I turn eighteen (18).	Using a mobile phone for learning would be better. But I don't know if I can be able to study using a phone because it is very small. Besides, I only have a very cheap phone which cannot use the internet.
P5	I usually spend about three hours using electronic content at school because I don't have internet access at home.	I prefer paper content because I will easily have access to it whenever I want. At my home, I easily have low voltage but with paper content I can access it even if there is power failure.	I have difficulties with internet connection and also, I am only able to study using electronic content when I get to school.	The graphic design.	No, I don't use social media during studies. Our teachers said it will distract us.	It will be a good idea. But I think it is better if we can be able to connect the phone to our TV so that we can see the letters properly.

P6	I spend about three hours a day studying at the internet café in town.	I prefer studying using text books and also getting lectures from the teachers because I can easy ask questions when I don't understand something and also I make my summaries in my book as I study.	Sometimes I am not able to study because there is no internet. I have internet and a laptop at home but the connection is slow and it takes a long time for the page to open when I want to log into the system.	To me it is almost the same like paper because I find it difficult to watch some videos because the connection is slow. Sometimes I will wish just to have my textbooks or the teachers' notes.	Yes I use social media. Our holiday classes teacher said we can send him messages if we have problems and need help.	What if you are trying to study and people keep on calling you. It may be a distraction. I don't feel it is a good idea to use your phone while studying. If I have a phone, I will switch it off when I want to study.
----	--	---	--	---	--	---

APPENDIX 5

Proof Reading Certificate



ProWriter Editing and Copywriting

Website www.prowriter.co.za/wpa/

Rob Ettershank

CFP - Adv. PostGrad Dip Financial Planning
(U.F.S.)

Retired Chartered Secretary/CERTIFIED
FINANCIAL PLANNER™

email robert@financialwisdom.co.za

Telephone 082 442 8972 P.O. Box 1429, Kloof,
3640

08 October 2016

University of
Cape Town
To whom it may concern,

Editing: Dissertation by Kinsley Ndenge

I, Robert John Ettershank, a practicing English language editor do hereby declare that an English language edit of the following academic work has been performed.

Secondary School Students' Perceptions of eContent Design: An Activity Theory Perspective

The work remains the original work of Kinsley Ndenge it is merely the English language that has been edited.

Yours faithfully

R.J Ettershank
CFP - Adv. PostGrad Dip Financial Planning (U.F.S.)
Retired Chartered Secretary/CERTIFIED FINANCIAL PLANNER™



Member SATI
Member Number:
1003319