THE CATHOLIC UNIVERSITY OF EASTERN AFRICA

FACULTY OF EDUCATION

DEPARTMENT OF UNDERGRADUATE STUDIES IN EDUCATION

AN INVESTIGATION ON THE EFFECT OF STUDENT CURIOSITY ON THE RETENTION OF SUBJECT MATTER

CASE STUDY: THE UNDERGRADUATE STUDENTS OF THE FACULTY OF EDUCATION OF C.U.E.A.

A RESEARCH PROJECT SUBMITTED TO THE FACULTY OF EDUCATION IN PARTIAL FULFILLMENT OF THE REQUIREMENT FOR THE DEGREE OF BACHELORS OF EDUCATION

BY

SAKINA ABIZAR TAYABALI

REG NO: 1024621

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NAIROBI, KENYA

DECLARATION

I, the undersigned declare that this research project is my original work. Sources of information used have been cited and acknowledged accordingly.

STUDENT: …….

SIGNATURE: ……

DATE: ……..

This research project has been submitted for examination by:

UNIVERSITY SUPERVISOR

NAME: ……..

SIGNATURE: ……

DATE: ……

H.O.D FACULTY OF EDUCATION

NAME ……

SIGNATURE: ……

DATE: …….....

DEDICATION

I dedicate this research to all educationalists with the hope that they can use it to make a difference in contemporary education.

Abstract

Curiosity is a means for students to fill in gaps in their knowledge. If their curiosity gets satisfied they are able to comfortably further their education. If not, the gaps remain unfilled and the students are left with a shallow knowledge base. They resort to cramming notes and information given by their teachers which they don't truly understand and which is later ignored and forgotten. The continuous assessment test scores of 65 undergraduate students from the Catholic University of Eastern Africa's Faculty of Education were analysed in accordance with the student's level of curiosity. A trend showing that a student's level of curiosity affects his/her retention of subject matter with regard to their test scores was observed. The students were questioned on what affects their level of curiosity in their respective subjects and factors such as quality of their lecturer's delivery of the subject content, level of understanding what the lecturer's teach and the amount of theory, influenced their curiosity in their subjects. The lecturers teaching the students were interviewed on how to increase their students' level of curiosity and they suggested on interactive learning, using audio and visual aids, use of technology and integration of various teaching methods. These research findings call for a change in education systems whereby educators encourage and trigger the curiosity of their students in their classes, in order to smoothen their students' transition from the known to the unknown.

ACKNOWLEDGEMENT

I would like to express my sincere gratitude to my parents for their moral support, my university supervisor Dr. Muhavini for his intellectual guidance and the University for allowing me to conduct this research. My gratitude goes out to my fellow colleague Chrispinus Munialo who encouraged me throughout the research process. I am also very thankful to the research participants who cooperated with me and gave me the information needed for this study.

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ABBREVIATIONS AND ACRONYMS

- ANOVA – Analysis of Variance
- CUEA – Catholic University of Eastern Africa
- CAT – Continuous Assessment Test
- Dr. – Doctor
- fMRI – Functional Magnetic Resonance Imaging
- ICT – Information and Communications Technology
- SN/VTA - Substancia Nigra/Ventral Tegmental Area

CHAPTER ONE

INTRODUCTION

1.1 Background

A Greek proverb states; “Wonder is the beginning of Wisdom”. A curious mind wonders about many things in order to quench its thirst for knowledge. The thirst for knowledge thus begins with curiosity. Ignorance only leads to lack of knowledge and wisdom, which in turn leads to lack of power (Drummond, 2006).

This research revolves around the words of Dr. Smiley Blanton (a Freudian psychiatrist) who said that “A sense of curiosity is nature’s original school of education”. The author Lloyd Alexander expounded this by saying, “We learn more by looking for the answer to a question and not finding it than we do from learning the answer itself.” It is thus through curiosity where we begin looking for answers and truly educating ourselves (Rockman, 2014).

Albert Einstein said, “Education is what remains after one has forgotten what one has learned in school.” This research aims to prove that curiosity is what leaves us with education and that it is the things we learn from curiosity that we remember even after we finish school.

1.2 Statement of the Problem

Majority of students in universities such as the Catholic University of Eastern Africa (Langata, Nairobi) do not ask many questions in class and so do not question the content they learn. They take it as it is by being overly dependent on teacher’s notes and other information the teacher gives them. Instead of understanding, they tend to cram the information given to them by the teacher and produce what they crammed in exams rather than use their own understanding to answer questions. After the exam, what was crammed escapes from their memory and so learning doesn’t really happen since they forget the concepts they crammed. Sometimes students forget what they crammed for the exam and thus perform poorly. The

inadequacy of curiosity in the subject prevents students from questioning what they learn and this leads to the student having a shallow knowledge base which results in poor retention of subject matter.

1.3 Purpose of the Study

The purpose of this study is to investigate how curiosity in students affects their retention of subject matter and suggest ways to increase the curiosity in university students so that through better retention of subject matter, their academic performance increases and they can achieve competence in their various fields thus allowing them to contribute positively to the society.

1.4 Research Questions

For the purpose of this study, the following questions are addressed:

1) Is the retention of subject matter affected by a student's level of curiosity in a subject?
2) What factors affect a student's level of curiosity in a subject?
3) What teaching methods and resources should be utilized in order to enhance curiosity in students?

As part of this study, investigation included one research hypothesis:

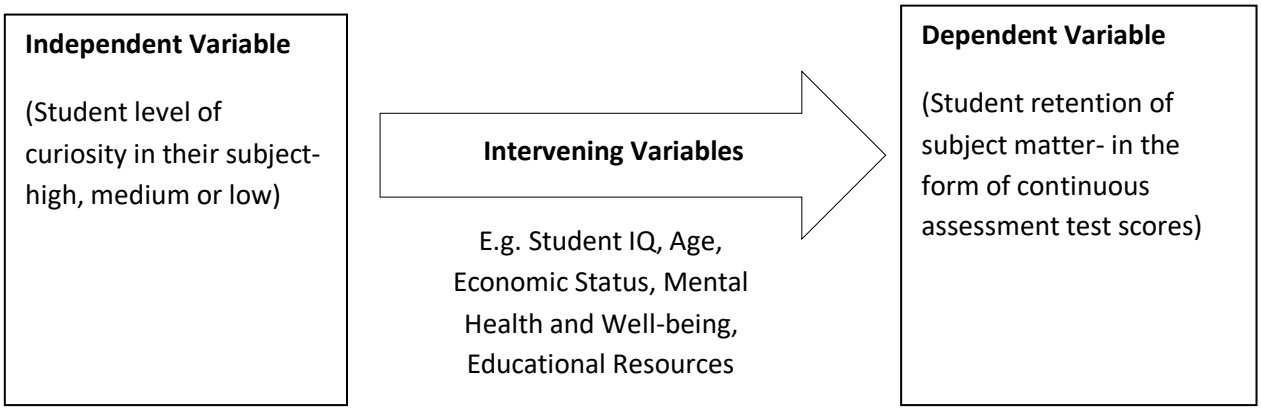
The retention of subject matter is affected by a student's level of curiosity in a subject. The more curious a student; the greater is his/her retention of the subject matter.

1.5 Scope and Delimitation

This research can be applicable to not only universities and colleges but also schools worldwide since it seeks to find out the factors that hinder students' from being curious about their course content and also to draw the conclusion that curiosity in a subject affects a student's retention of subject matter.

However, data collection for this research is limited to university students taking Education subjects in the Catholic University of Eastern Africa so we cannot use all the data collected when dealing with other courses in educational organisations since type of educational organisation, the age of students and their level of education would not be the same.

1.6 Conceptual Framework:



1.7 Definition of Terms

- Curiosity – a desire to know, see and experience that which motivates exploratory behaviour directed towards the acquisition of new information (Litman, 2005). Curiosity describes a disposition to explore and question (Renninger, 2015).
- Retention – the preservation of a learning experience which makes recall and recognition possible.
- Intrinsic Motivation – performing an action or behaviour because one simply enjoys the experience in itself.
- Exploratory behaviour – the tendency to explore or investigate a novel environment also called novelty-seeking-behaviour (Berlyne, 1954).

CHAPTER TWO

LITERATURE REVIEW

The literature used to build up on this project comes from established journals, articles and websites. 'Curiosity' on its own is a general part of human nature and scholars have studied aspects of it. The aspect of curiosity affecting recall and memory (which is the basis of my research project) is moderately studied and the studies made in this area are very recent.

2.1 Curiosity and learning

In study on *Measuring Epistemic Curiosity and its Diversive and Specific Components,* a general description of curiosity was given. They defined curiosity as a 'desire' to obtain new knowledge and experiences which ultimately motivate exploratory behaviour. Moreover they used Daniel Berlyne's studies to categorize curiosity into Perceptual and Epistemic Curiosity. Perceptual curiosity leads to the awareness of stimuli while Epistemic Curiosity is a 'drive to know' the concepts to fill in the gaps in one's knowledge (Litman & Spielberger, 2003).

Another distinct classification of curiosity is state and trait curiosity. State curiosity is a fleeting arousal of curiosity due to an environmental stimulus whereas trait curiosity is longer lived due to an internal stimulus or drive to satisfy the curiosity (Clark, 2010).

This research project looks at how much of epistemic and trait curiosity in students is required to improve their recall and retention of what they learn.

Curiosity is a form of intrinsic motivation. Intrinsic motivation involves an interest in a certain activity only because of the inner pleasure received while performing it. Studies conducted in the early 1970s found out that intrinsically motivated students willingly engage in activities for the sake of skills improvement and/or knowledge enhancement. Intrinsic

motivation in these students was caused by their interest in mastering a topic rather than learning the subject to get good grades (Sincero, 2012).

An empirical study done on Hong Kong education found that curiosity is positively correlated to a student's intrinsic motivation which in turn positively affects learning and academic performance (Hon-keung, Man-shan & Lai-fong, 2012).

Curiosity is thus a motivator which allows students to take responsibility for their own learning and this may play a part in helping them retain what they learn.

2.2 Theories on Curiosity

There are two major theoretical accounts of curiosity: *curiosity- drive theory* and the *optimal arousal model*.

The first curiosity drive theory equated curiosity to an unpleasant experience of uncertainty whose reduction is rewarding. Curiosity drive theorists assumed that novel, complex and ambiguous stimuli disrupted coherence but after gaining new information about the stimuli, cognitive and perceptual coherence got restored.

Unlike the curiosity drive theory, optimal arousal theorists assumed that curiosity induction involves feelings of interest rather than uncertainty. According to the optimal arousal model, under aroused (bored) individuals are motivated to increase their arousal to an optimal level and explore environment in search of stimuli which may excite their curiosity and generate positive feelings of interest. When the new information has been obtained, boredom is assumed to return and individuals are motivated to seek new rewarding information again. However when individuals encounter demanding and stressful stimuli which cause them to experience high levels of physiological arousal, they may be motivated to avoid the stimuli altogether (Litman, 2005).

Optimal arousal models show that individuals seek out stimuli to arouse their curiosity but do not explain why curious individuals would want to have their curiosity

satisfied if it would in the end only reduce their positive arousal of curiosity to less than optimal levels (Litman, 2005).

Contemporary models of curiosity have built up on the ideas of drive and optimal arousal theories of curiosity.

Loewenstein's *knowledge gap/approach gradient theory* of curiosity states that curiosity arises from an information gap – a difference between what one knows and what one wants to know. This theory assumes that a small increase in knowledge creates an information gap which grows with initial learning. When one feels sufficiently knowledgeable, the information gap reduces and curiosity falls. Curiosity to this theory is and infinite rewarding stimulus and unknown information is anticipated to be rewarding (Kang, Hsu, Krajbich, Loewenstein, McClure, Wang, & Camerer, 2009).

In 1994, Spielberger and Starr also proposed an *optimal stimulation/two process model* which showed that in order to introduce and maintain curiosity, individuals are motivated to approach new and unusual stimuli, but if these stimuli are dangerous or threatening, curiosity and exploration may be inhibited by unpleasant states of anxiety. In support of their model, students with high trait curiosity asked more questions when their teacher was thought to be non-threatening. If the teacher was thought to be threatening, no difference between students of high trait curiosity and those of low trait curiosity was found. Individual differences in curiosity of people with different personality could clearly be seen when conditions of learning are non-threatening as those with higher state curiosity could have room to experience more trait curiosity (Litman, 2005).

In 2005 Litman and Jimerson developed an *Interest-Deprivation (I/D) theory* of curiosity. Their I/D model relates to the neuroscience of wanting and liking the attainment of new information. They noted the fundamental limitation to drive and optimal arousal models of curiosity was the failure to consider that both the satiation and activation of curiosity could

be rewarding. By adapting the knowledge gap/ approach gradient and optimal stimulation/two process models, they proposed that curiosity could be aroused when individuals feel as though they are deprived of information, and wish to reduce their ignorance, even though they have a bit of information; they would nevertheless enjoy learning more (Litman, 2005).

Thus by concluding that curiosity has an overall rewarding effect, the I/D model shows a relationship between all the previous models of curiosity. However it does not show how the rewarding effect of curiosity affects memory and the retention of knowledge.

In support of the curiosity drive theory, studies in 1954 by David Berlyne on curiosity and memory found that answers to general knowledge questions rated as more puzzling and stimulating more uncertainty were better remembered, indicating that learning was reinforced as curiosity was reduced.

2.3 Factors affecting curiosity

A curious individual seeks new experiences and answers to problems. Insufficient new experiences lead to boredom and restlessness. If the unusual is too strange and new, it may arouse temporary state of fear but curiosity dominates and the individual proceeds to explore until his curiosity is satisfied. Parents and teachers are the most important factors in promoting curiosity. Healthy psychological adjustment with the environment is associated with high curiosity. The richer the environment, the more curious an individual becomes (Singh, 1997).

Young children are spontaneously curious about new and unusual things. Several research studies conclude that curiosity is highest during ages 3-5. As they grow older, children seem to be less willing to reach out into new experiences due to barriers been raised to block such explorations. Barriers such as conflict, fear and anxiety decrease curiosity (Maw & Maw, 1966).

Authoritarianism or reinforcement towards an individual's curious nature by a care giver or teacher may affect the individual's extent of exploration. By being stopped by outside forces from being curious about something, one may withdraw from the novel stimulus altogether.

Children who learn that they can explore successfully, continue to explore; whereas those who are thwarted, are hesitant to explore and thus their curiosity diminishes. Due to this learned fear of knowledge, curiosity with age decreases in varying degrees. In a 1996 case study by Alice Colonna, lack of self-esteem in the child being studied due to her mother stopping the child's impulses to explore resulted in a later follow up showing she was severely not persistent in her curious drives (Piccone, 1999).

The more a child's questions go unanswered the less courage the child has to ask more questions. The suppression of curiosity as one grows older by family attitudes, educational systems and the influence of society results in low level of exploratory behaviour later on in the individual's life.

By answering a student's questions, rewarding their curiosity and constantly providing new and unusual stimuli in a non-threatening environment may boost a student's curiosity and level of learning.

2.4 Indicators of Curiosity

A curious individual is more open to exploring and learning than another by filling in gaps in knowledge or responding to uncertainty, novelty, surprise, challenge or complexity with the likelihood that they will engage in exploration.

The amount of time they give in doing a task and how much they participate in it shows how much they are engaged in the task and in turn shows show curious they are. By being engaged they give more value to the task. The value the student gives to their work and

how strongly they feel about doing it shows interest and leads to them being more curious about it.

The will to engage in a task and be curious about it brings about motivation. Intrinsically motivated students set goals, self- regulate and exert effort to achieving their goals (Renninger, 2015).

There are 4 stages of curiosity: process, content, transfer and self. Each stage has its own indicators of curiosity. At the 'process' stage the learner asks questions which show signs of beginning curiosity such as "why do I have to learn this' and 'when will I use this in real life'. At the 'content' stage, the learner monitors their own understanding by providing questions and answers which seek to correct misconceptions. At the transfer stage the learner offers more questions than answers and tries to persevere in gathering new knowledge. Finally at the 'self' stage the learner demonstrates emotions such as excitement or sadness, and seeks space and quiet to reflect and give insight on what they've learned. The effects of what they've learned emerge and learning finally has taken place (Heick, 2015).

2.5 Curiosity and the Brain

Curiosity gives the motivation to learn new information or tasks and this gives a rewarding feeling. Parts of the brain work together to process reward and are called the reward pathway. Neurotransmitters involved in this pathway such as dopamine are linked to the process of curiosity as they assign and retain the rewarding information gained. A higher amount of dopamine is released when reward is unknown and stimulus is unfamiliar arousing curiosity compared to when stimulus is familiar and reward is known (Costa, Tran, Turchi, & Averbeck, 2014).

A correlation was found between the amount of grey matter in the area of the brain involved in episodic memory and attention called the precuneus, and the levels of curiosity and exploratory behaviour (Kimberley, Francys & Chet, 2012).

Curiosity demands attention and this shown when individuals tend to focus on new and unfamiliar stimuli to make sense of the unknown over the more familiar or repetitive stimuli (Stuart, Cecelia, Allan, & James, 2011).

Memory plays a very important role in checking the level of novelty or unfamiliarity and the level of need for curiosity on information and experiences. In order to determine whether the stimulus is novel, one must remember whether the stimulus has been encountered before. The hippocampus of the brain is associated with memory. The area of grey matter surrounding the hippocampus called the parahippocampal gyrus (PHG) has recently been implicated in the process of curiosity. The findings suggested that the PHG is involved in amplifying curiosity (Kang et al, 2009).

Before the introduction of functional magnetic resonance imaging (fMRI), researchers did not know where, how and why curiosity arose in the brain. The amyglada in the brain was known to be important in processing emotional reactions towards novel or unexpected stimuli and inducing exploratory behaviour (Montgomery, 1955).

By using fMRI, researchers found curiosity to be an emotion and that the amyglada, showed activity during the event of curiosity (Smith, 2015).

2.6 Curiosity and its effect on memory and learning

In 2009, a study was conducted on how Epistemic curiosity activates the reward pathway in the brain and enhances memory. The findings were presented in a research article titled “The Wick in the Candle of Learning.” Individuals in this study were tested with fMRI as they read trivia questions. The fMRI showed activity in regions of the brain involved in anticipating reward when the individuals showed curiosity while reading the questions. Individuals who incorrectly guessed the answers to the trivia questions and showed curiosity in knowing the correct answer displayed activity in the areas of the brain involved in memory. This suggested that curiosity enhanced memory with surprising new information

and this was proved when it was found that 1 to 2 weeks later, better recall of surprising answers to the trivia questions correlated with higher levels of curiosity displayed when first answering those questions (Kang et al, 2009).

In 2014, another in depth study led by Matthias Gruber of the University of California used fMRI to investigate how curiosity as an intrinsic motivation to learn, influences memory. The researchers subjected participants to various trivia questions and asked them how curious they were about each question (Andrew & Knox, 2016).

Under fMRI, the participants' brain activity was measured as they were subjected to the questions again. While they waited for the answer to each question an image of a random person's face was displayed. After a delay a surprise memory test was given and the results showed that the participants remembered the answers to trivia questions they were curious about as well as the faces which came along with those questions. After 24 hours the retention of the faces which corresponded to the questions the participants were curious about was better than the retention of those faces corresponding to questions the participants weren't curious about. This suggests that curiosity puts the brain in a state that allows it to learn and retain any kind of information that surrounds what one is motivated to learn (Gruber, Gelman, & Ranganath, 2014).

The fMRI showed that once curiosity was aroused there was increased activity in the nucleus accumbens and substancia nigra/ventral tegmental area (SN/VTA), which are part of the reward circuity in the brain. As participants anticipated the answers to questions they were curious about, activity in the hippocampus was observed proving that curiosity prepares the brain to remember the new information and retain it in the memory. The fMRI also showed increased interactions between the SN/VTA and the hippocampus when participants were curious. These interactions kept the brain in a state which allowed one to be more likely

to learn and retain rewarding information along with the information that is not of particular interest as long as one remained curious (Gruber et al, 2014).

The results of this study can be applied in teaching and learning. By first arousing curiosity in students with rewarding information, teachers can then be able to teach complex and 'boring' subject content which facilitates students to be able to grasp and retain it.

The above studies showed that the brain rewards one for exploring new ideas by being curious and this rewarding effect helps one remember what they learn.

The literature discussed has explained the theory behind curiosity and shown that curiosity affects the different areas in the brain which help a person interested in learning new ideas, and this interest allows them to retain what they learn. However, the study of curiosity with regard to the brain is still in its early stages and more research is needed to know the root source of curiosity in relation to human memory. There is also limited research on how curiosity in students affects their recall of all they learn in class. Educators still need to know how to increase the curiosity of each and every student in their respective subject so that by doing so, it can facilitate the retention of the subject matter.

CHAPTER THREE

RESEARCH DESIGN & METHODOLOGY

This chapter will outline the research design chosen, the target population of the study, the sample size, data instruments used and the data analysis techniques.

The study will take place in the Catholic University of Eastern Africa, Langata campus Nairobi, Kenya. It will focus on 5 classes of undergraduate students pursuing Bachelors of Education degrees and the lecturers teaching them during May to August 2016.

3.1 Research design

The research will be executed using a mixed methods research design involving collecting, analysing and integrating quantitative and qualitative research to provide a better understanding of the research problem.

3.2 Sampling

The target population will consist of the undergraduate education students of CUEA during May to August 2016. A non-probability sampling procedure will be carried out and out of convenience, 5 classes will be selected (having undergraduate students from the faculty of education) each taking place from 8:00 am to 11:00 am where all the students will be given questionnaires and the lecturers interviewed. The sample size limited to the selected 5 classes will be 65 students.

3.3 Instrumentation

This study will use the following data collection instruments in order to investigate the effect of a student's curiosity on the student's retention of subject matter.

Questionnaire - Closed and open ended questions will be asked to the students to find out their ordinal level of curiosity (high, medium or low) and get data (their test scores out of 30 marks) which is an easily quantifiable measure of their retention of subject matter.

Interview guides - Face to face interviews will be held to get information from lecturers. This will allow the interviewer to get an opportunity for clarifications, in depth answers and a detailed viewpoint.

Observation - This will allow the researcher to see the students who possess trait curiosity and those who don't in a class and then obtain their respective test scores. By observing the students in their natural setting, the researcher can gain in depth understanding of the research problem and obtain valid results.

3.4 Data Collection and Analysis Procedures

A letter of consent will be administered and collected from the Head of Department of Education in CUEA. The study will be conducted in a duration of 2 weeks where the researcher will be allocated times to interview lecturers and observe their respective classes. The questionnaires will be given to each student in each class to fill in and submit by the end of their lesson.

The data collected will be analysed using frequency tables and charts. ANOVA will be the statistical test used to analyse the results from the questionnaire.

3.5 Protection of Human Rights and Ethical Considerations

Efforts will be taken to ensure the privacy rights of the participants involved are observed. The subject's participation would be voluntary and the subject's confidentiality will be protected.

This research will primarily be for academic purposes only and publishing acts will be followed.

CHAPTER FOUR

RESULTS & DATA ANALYSIS

Data gathered from questionnaires, interviews and observation resulted in the following research findings which are presented in a manner that addresses the research questions.

4.1 Demographics

A total of 65 undergraduate students in 5 classes all in the faculty of education of the Catholic University of Eastern Africa; responded to the questionnaires.

4 lecturers out of the 5, each teaching the classes under study, were interviewed. The lecturers were all qualified to teach their respective subjects with Masters and Doctor of Philosophy degrees.

4.2. Results for the 1st Research Question - Is the retention of subject matter affected by a student's level of curiosity in a subject?

Each student's level of curiosity was assessed qualitatively through observation and scoring of answers to questions 2-7 of the questionnaire. A score of 9-12 implied a high level of curiosity in which the student is very interested in the subject, pays full attention in class, participates actively, reads widely and researches to fully understand what's taught in the unit. A score of 5-8 implied a medium level of curiosity in which the student is mildly interested in the subject, participates very little in class discussions, uses a limited variety of learning aids and has an average level of understanding of concepts. A score of 0-4 implied low level of curiosity in which student does not question what he/she learns and has poor attention and participation in class with a low level of understanding of concepts.

The student's CAT scores out of 30 marks showed a measure of the student's retention of the subject matter.

Table 1 records the CAT scores of students with high, medium and low curiosity in their respective classes according to the results from the questionnaires and through observation of the students by the researcher. Figure 1 shows a bar graph of the results from table 1 demonstrating the trend in which level of curiosity in each class determines the average C.A.T scores of students.

The trend seen in all classes is that students with high level of curiosity have greater average CAT scores than students with medium level of curiosity. In classes 1, 2 and 3, the trend is that students with high level of curiosity have greater test scores than those with both medium and low curiosity; whereas those with medium level of curiosity have average test scores greater than those with low curiosity.

Table 1: CAT scores of students at their respective level of curiosity in their subject:

Curiosity level of students:	Student Test scores out of 30 marks				
	Class 1 (Total 26 students)	Class 2 (Total 5 students)	Class 3 (Total 10 students)	Class 4 (Total 9 students)	Class 5 (Total 15 students)
High	25 11 17 24 20 15 20 26 29	25 24 20 25	24 18 22 23 23	24 23 24 25	25 21 23 18
Average CAT score for high level of curiosity	**20.8**	**23.5**	**22**	**24**	**21.8**
Medium	23 21 16 15 20 20 23 22 20 25 17	20	18 21 22 18 20	23 24	17 22 14 14 18 20 17 17 22

	20 25 17 25				
Average CAT score for medium level of curiosity	**20.6**	**20**	**19.8**	**23.5**	**17.9**
Low	8 13	-	-	22 22 21	20 15
Average CAT score for low level of curiosity	**10.5**	-	-	**21.7**	**17.5**

Figure 1: Average C.A.T scores of students with high medium and low curiosity in their respective classes.

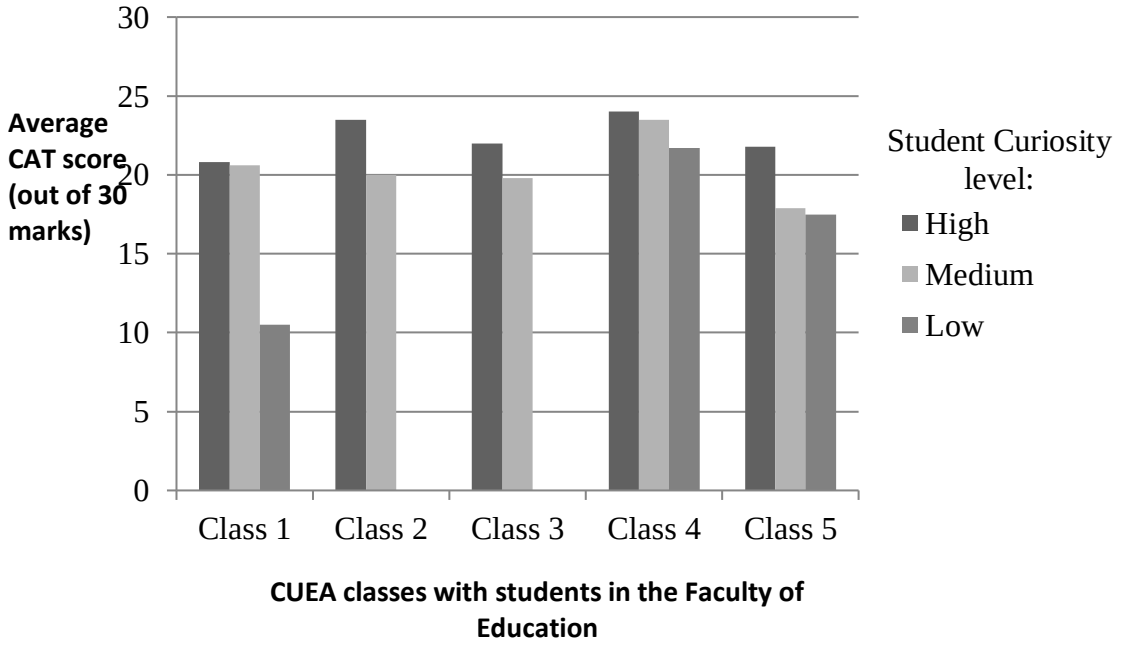


Table 2 shows the CAT scores of all the 65 students in the sample studied ordered in accordance to each student's level of curiosity. Figure 2 uses the average CAT scores at each level of student curiosity from Table 2 demonstrating that as the level of curiosity increases, the average CAT score increases.

Furthermore, one way ANOVA was carried out on the data in table 2a to know if there is a significant difference between the means of the CAT scores at each level of

curiosity. Table 2b shows the summary of the data from Table 2a which was used to get the results to the ANOVA which are shown in Table 2c.

The two hypotheses which guide the results from ANOVA and answer this first research question are as follows:

The null hypothesis for this research is that there is no significant difference between the student's CAT score and the student's level of curiosity in the subject.

The alternate hypothesis for this research is that there is a significant difference between the student's CAT score and the student's level of curiosity in the subject.

Table 2a: CAT scores out of 30 marks of the 65 students in research sample with high, medium and low curiosity:

CAT scores of students at their respective levels of curiosity		
High	**Medium**	**Low**
25	23	8
11	21	13
17	16	22
24	15	22
20	20	21
15	20	20
20	23	15
26	22	
29	20	
25	25	
24	17	
20	20	
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	22	

Table 2b:	**Treatments - Level of curiosity**			
	High	**Medium**	**Low**	**Total**
N	26	32	7	65
∑X	574	636	121	1331
Mean	22.0769	19.875	17.2857	20.4769
∑X2	13046	12946	2267	28259
Std.Dev.	3.867	3.1392	5.4072	3.9612

Figure 2: The effect of increasing level of curiosity of students on their average CAT scores

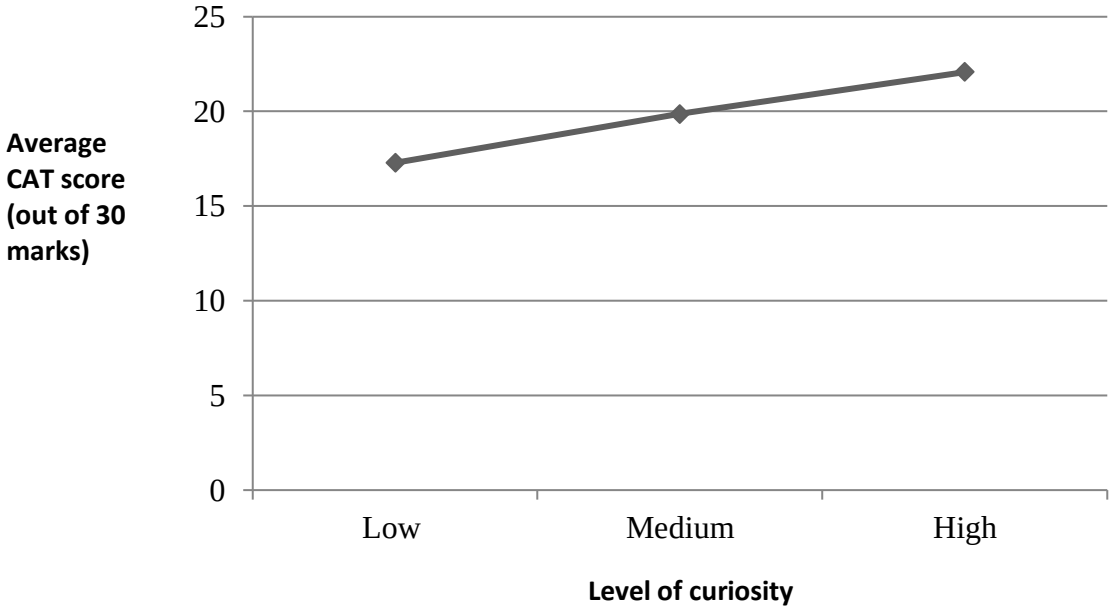

Table 2c: Results of one way ANOVA from data in Table 2a

Source of variation	**SS**	**df**	**MS**	**F (calculated)**	**F tabulated)**	**p**
Between Treatments	149.4407	2	74.7203	5.41974	3.1453	0.006773
Within Treatments	854.7747	62	13.7867			
Total	1004.215	64				

Since the result is significant at $p < 0.05$ and since the calculated F value is greater than tabulated F value (at numerator degrees of freedom 1 and denominator degrees of freedom 62) at 95% confidence level, the null hypothesis is rejected and the alternate hypothesis accepted.

4.3 Results for the 2nd research question: What factors affect a student's level of curiosity in a subject?

To obtain the results for this research question, the researcher used the student's answers to the open ended question 10 of the questionnaire. Table 3 shows the main types of responses given to question 10 (which asked the students to list down the reasons which affect their level of curiosity in their respective unit).

Table 3: Student responses to the reasons which affect their level of curiosity in their respective units

Types of student response	Tally of students who responded this way
Passion for the unit is mild	|||
Lecturer delivery is good	𝍸
Lecturer delivery is poor	𝍸 |
Interesting, useful and relatable subject content	𝍸 𝍸 𝍸 𝍸 𝍸
Language problems	𝍸
Long lesson hours and loss of concentration	𝍸 |||
Low level of understanding in difficult topics	𝍸 |
Heavy workload	|
Too much notes and theory	𝍸 ||
Distractions in the class	|

With regard to the above student responses, interesting subject content which can be related to real life issues is a strong factor affecting the 29 students' curiosity in their subject. 11 students found the quality of lecturer's delivery of the unit as a factor affecting their curiosity level. Out of the 11, 5 believed that the lecturer who gave a 'good' lesson which held their interest, made them more curious about what the lecturer was teaching them. On the other hand 6 out of the 15 felt that the lecturer who was too 'strict' and monotonous did not arouse their curiosity in class. 8 students felt that long lesson hours affect their concentration span and make it hard for them to stay focussed and curious in what the lecturer is teaching. 7 students found that too much of theory and notes given to them by the lecturer reduced their curiosity level. 6 students stated that their level of understanding of the subject content itself influenced their level of curiosity and difficult topics which were not made clear to them did not arouse their curiosity. 5 students shared that they had problems with language and understanding the lecturer. 3 students believed their overall passion for the unit affects their curiosity level in the unit and other factors such as a heavy workload and class distractions were mentioned by two students respectively.

4.4 Results for the 3rd research question: What teaching methods and resources should be utilized in order to enhance curiosity in students?

The answer to this research question was obtained from interviewing the lecturers of the classes studied. They gave the following suggestions to improve curiosity in students:

- Use of audio and visual aids
- Interactive learning
- Problem solving & Enquiry learning
- Giving reading assignments to encourage students to read widely on their own and later share in class what they have learnt.
- Use of ICT – PowerPoint Presentations, Learning Software, E-learning

When asked about the teaching methods used to ignite curiosity, the lecturer teaching Class 5 stated that "by integrating all kinds of teaching methods and not just using one or two, can we hope to make a lesson that can arouse a student's curiosity. A balance of lecture method with group discussion, independent study, demonstrations, practical learning, enquiry learning and even taking students out on field trips can be used to enhance a student's curiosity of the subject matter."

Likewise, the lecturer for Class 4 said that "by using a variety of teaching resources including audio and visual aids, textbooks, notes and ICT; we can bring about curiosity in students on the subjects they study at university level."

CHAPTER 5

SUMMARY, CONCLUSION AND RECOMMENDATION

This final chapter discusses the findings and summarizes this research project. Generalizations in the form of conclusions will be made and the recommendations by the researcher will be addressed to those concerned.

5.1 Summary of research

This study was conducted for the purpose of determining whether the level of a university student's curiosity affects their retention of subject matter, investigating the factors affecting student curiosity and finding out ways to increase curiosity in students at university level. The literature reviewed concentrated on the theoretical aspect of curiosity and how it affects the human brain's ability to retain what it learns.

For this project, a mixed method of research was used to support quantitative data (the CAT scores out of 30 marks which corresponded to retention of subject matter) with qualitative methods (observing level of curiosity in students). Questionnaires, interviews and observation were the research instruments used. The numbers of respondents in this study were 65 students and 4 lecturers. A non-probability sampling technique was used to select the 5 classes with the 65 students from the faculty of education in CUEA. The study took place during the May – August 2016 semester.

5.2 Discussion of research findings

This research was guided by 3 research questions. The results to the first research question (Is the retention of subject matter affected by a student's level of curiosity in the subject?) showed a trend in which the average CAT scores of students with low curiosity in their respective subject were much lower than those with medium level of curiosity. The average CAT scores of students with high level of curiosity in their respective subjects were higher than those with both medium and low curiosity. A significant difference was found

between the average CAT scores of students at each level of curiosity. This shows the level of curiosity affects the student's retention of the subject content.

The second research question (What factors affect a student's level of curiosity in a subject?) gave results regarding the student's interest in the subject content, quality of lecturer's delivery of subject content, time taken in teaching topics each lesson, concentration span of students, amount of theory in the subject, clarity of language used in teaching, student level of understanding, and overall passion for the subject.

The above factors relate with the studies by (Singh, 1997), (Maw & Maw, 1966) and (Piccone, 1999) that a richer and psychologically healthy learning environment, with reduction of conflict, fear and anxiety from teachers enforces curiosity in students.

The third research question (What teaching methods and resources should be utilized in order to enhance curiosity in students?) gave results such as interactive learning through audio and visual aids, use of ICT in learning, e-learning, problem based/enquiry learning, practical demonstrations and field work, and an overall integration of all kinds of teaching methods to make learning more interesting for the learner.

The limitations to the above findings are due to less time put in researching the factors affecting curiosity level and retention of subject content of each student in the sample size. Those introverted students who did not actively show their curiosity in the classes observed may still exhibit high curiosity in their subject. There may also be students who actively participate in class and seem to show curiosity in what they are learning but do not really perform well in the given CAT. The CAT itself may not be enough to show their true level of retention.

5.3 Conclusion

By undertaking this project the researcher gained exposure to the skills needed in conducting applied research such as knowing how to ethically collect and present research

findings, using statistical tests to analyse quantitative data, striving for reliability and validity in the data, and appreciating the overall hard work and dedication needed to successfully present the research.

In conclusion, this research was able to find answers to all the research questions and reinforce on the scholarly research previously conducted in this area of research. The retention of subject matter is affected by a student's level of curiosity in the subject. Factors such as quality of subject delivery by the lecturer, lesson length, level of understanding of the subject by the student, amount of theory and practice in the subject; all affect a student's level of curiosity in his/her respective subject. In order to enhance curiosity in students, not just one or two, but a variety of teaching methods and resources should be used in class.

5.4 Recommendations

To overcome the limitations of this research, more time is needed in observing students and their level of curiosity in their subjects and measuring their retention of subject matter over a longer period of time.

Further research on curiosity in students is needed to empower the nation's education systems. Research on individual forms of teaching methods and their effectiveness in arousing curiosity in students is recommended. The use of ICT in classes would greatly empower learning and trigger students' curiosity in their subjects. The more the level of argument and questioning done by a student in a subject, the more he/she will be able to grasp and retain what is being learned. Therefore, students should be encouraged by teachers in class to be curious about the unknown in their respective subjects.

Questions which students ask should be treated with importance. Students should not be considered disruptive if they ask questions in class. The Socratic method of asking and answering questions to stimulate critical thinking and drawing out ideas, should be used by teachers and students, as this would help the students in retaining the subject content.

The significance of this area of research demands further attention by the Ministry of Education and all educational organisations. This is in order to satisfy the inquiring and curious minds of all students at all levels of education, establishing in them a strong knowledge base, through better retention of subject matter.

APPENDIX

QUESTIONNAIRE FOR UNDERGRADUATE STUDENTS OF

THE CATHOLIC UNIVERSITY OF EASTERN AFRICA

RESEARCH TOPIC: *Investigating the effect of student curiosity on the retention of subject matter*

The purpose of this research is to test whether a student's curiosity in the subject content affects how much the student remembers in the subject after learning has taken place. It also aims to find out the factors affecting how much curiosity a student can have in a subject and how it can be possible to increase curiosity in a subject for better learning.

Instructions: Please respond to the 10 questions below, putting a tick in the correct answer box.

Phone No. ……

1) What is the name of the unit you are taking this questionnaire in?

   …….

2) How interested are you in this unit?

   A) Very interested ☐

   B) Mildly interested ☐

   C) Not too interested ☐

3) How attentive are you in class?

   A) Throughout the lesson ☐

   B) I try to pay attention but lose focus at times ☐

   C) Never pay attention ☐

4) How much do you participate in class?

   A) I ask questions and express my opinion almost every lesson ☐

   B) I ask questions and express my opinion sometimes ☐

C) I do not ask questions and express myself in class ☐

5) How much time do you give to study for this unit?

A) I study almost everyday ☐

B) I study once a week or two ☐

C) I study only day/s before a test ☐

6) Which learning aids do you use to study for this unit?

A) Teacher's notes only ☐

B) Teacher's notes and library books ☐

C) Teacher's notes, library books and Internet resources ☐

7) How do you study the concepts in this unit?

A) I question the subject content, research what I don't understand and make short notes in my own words ☐

B) I read through and try to understand what I can. I ignore what I just don't understand ☐

C) I cram my teacher given notes and try to memorise what I can ☐

Please state any other way

……..

8) In the test you've done so far in this unit, what was your score out of 30 marks?

……

9) Can you still remember all that you've learnt in this unit even after the test?

Yes ☐ No ☐

10) List down the reasons which affect your level of curiosity in this unit:

Thank you for participating in this study.

Scoring for answers:

Question 2, 3, 4, 5 and 7: A=2 points B= 1 Point C= 0 point

Question 6: A=0 points B=1 point C= 2 points

Analysis of total scores –

9- 12: high level of curiosity in respective unit. Student is very interested, pays full attention, asks questions and participates regularly in class. He/she studies almost every day for the unit, reads widely and researches to understand fully what's taught in the unit.

5-8: medium level of curiosity in respective unit. Student is mildly interested, tries to pay attention, participates very little in class discussions, uses a limited variety of learning aids and has an average level of understanding of concepts.

0-4: low level of curiosity in respective unit. Student is not interested and hardly pays attention or participates in class. He/she rarely questions subject matter and has a poor understanding of concepts.

INTERVIEW GUIDE FOR CLASS LECTURERS

Name of lecturer	
Subjects he/she teaches	
Qualifications and competence level	
Average number of units they teach in each semester	
Average number of students in each unit	
Teaching methods he/she uses	Lecture Group Discussion Independent study Demonstrations Practical learning Field trips Problem-based/enquiry learning e-learning
Variety of teaching resources he/she uses	Audio and visual aids Textbooks Notes ICT Other…
Their teaching personality	authoritarian, democratic or laissez faire
Describe level of student participation in class	High, medium, low
Performance in most active class	High Average Low
Performance in least active class	High Average Low

How much do their students question what they learn from lecturer	A lot, enough, not too much
How many reading & writing assignments do they give their students in each unit?	Many, a few, none
Performance of students with a high curiosity in subject	High Average Low
Performance of students with low curiosity in the subject	High Average Low
Suggestions on which teaching methods to use in order to increase curiosity in the students	

OBSERVATION GUIDE:

Date:

Time:

Class:

Lecturer:

Students asking questions and showing curiosity in subject content by reading widely:		Performance in C.A.T
Name & Reg. no	Contact	
Students not participating in class and not reading widely:		Performance in C.A.T
Name & Reg. no	Contact	

Description of class environment:

Analysis of observation:

REFERENCES

Andrew, E., & Knox, M. (2016). Curiosity Activates Brain To Boost Learning Experience. Retrieved from http://www.iflscience.com/brain/curiosity-activates-brain-boost-learning-experience/

Berlyne, D. E. (1954). A theory of human curiosity. *British Journal of Psychology.* 45, (3) 180-191

Clark, J. (2010). How curiosity works. Retrieved from http://science.howstuffworks.com/life/evolution/curiosity2.htm

Costa, V. D., Tran, V. L., Turchi, J. , & Averbeck, B. B. (2014). "Dopamine modulates novelty seeking behavior during decision making".*Behavioral Neuroscience* 128 (4): 1–11

Drummond, C. D. (2006) *Wonder and Wisdom: Conversations in science, spirituality and theology* (1st ed.) Philadelphia: Templeton Foundation Press. Retrieved from https://www.templetonpress.org/sites/default/files/Wonder_Wisdom.pdf

Gruber, M. J., Gelman, B. D., & Ranganath, C. (2014) States of curiosity modulate hippocampus-dependent learning via the dopaminergic circuit. *Neuron.* 84,(2).486-496 Retrieved from http://dx.doi.org/10.1016/j.neuron.2014.08.060

Heick, T. (2015) 4 stages of curiosity. Retrieved from http://www.teachthought.com/critical-thinking/inquiry/4-stages-of-curiosity/

Hon-keung, Y., Man-shan. K. & Lai-fong, C. A. (2012). The impact of curiosity and external regulation on intrinsic motivation: An empirical study in Hong Kong education. *Psychology Research*, 2, (5). 295-307

Kang, M. J., Hsu, M., Krajbich, I. M., Loewenstein G., McClure, S. M., Wang, J. T. & Camerer C. (2009). The wick in the candle of learning: Epistemic curiosity activates

reward circuitry and enhances memory. *Psychological Science.* Retrieved from http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1308286

Kimberley, A., Francys, S., & Chet, C. (2012). Curious monkeys have increased gray matter density in the precuneus. *Neuroscience Letters.* 518: 172–175 Retrieved from http://www.sciencedirect.com/science/article/pii/S0304394012006398

Litman, J. A., & Spielberger, C. D. (2003). Measuring epistemic curiosity and its diversive and specific components. *Journal of Personality Assessment, 80*(1), 75-86. doi:10.1207/s15327752jpa8001_16

Litman, J. A. (2005). Curiosity and the pleasures of learning: Wanting and liking new information. *Cognition and Emotion*, 19, (6). 793-814

Loewenstein, G. (1994). The psychology of curiosity: A review and reinterpretation. *Psychological Bulletin.* 116, (1). 75-98

Maw,W. H., & Maw, E. W. (1966). Children's curiosity and parental attitudes. *Journal of Marriage and Family*. 28, (3). 343-345

Montgomery, K (1955). The relation between fear induced by novel stimulation and exploratory behavior. *Journal of Comparative and Physiological Psychology*. 48 (4) 254–260. Retrieved from: doi:10.1037/h0043788

Piccone, J. (1999) Curiosity and Exploration. Retrieved from http://www.csun.edu/~vcpsy00h/students/curious.htm

Renninger, K. A., (2015) On defining and assessing engagement, interest, curiosity and motivation in informal science learning. Retrieved from http://sites.nationalacademies.org/cs/groups/dbassesite/documents/webpage/dbasse_072562.pdf

Rockman, C. (2014) Teachers Guide: The Book of Three, (50th ed.) Macmillan Publishing Group. Retrieved from http://images.macmillan.com/folio-assets/teachers-guides/9780805080483TG.pdf

Sincero, S.M. (2012, February 26). Intrinsic and Extrinsic Motivation. Retrieved from https://explorable.com/intrinsic-and-extrinsic-motivation

Singh, B. (1997). *Preschool education*. New Delhi: APH Pub. Retrieved from https://books.google.co.ke/books?id=Imw3wHN2clQC&pg=PA109&lpg=PA109&dq=factors+affecting+curiosity&source=bl&ots=vhHlvAtyDE&sig=TGI9_13oCy0ehcXnMeF52Fmdt-o&hl=en&sa=X&redir_esc=y#v=onepage&q=factors%20affecting%20curiosity&f=false

Smith J. (2015). 5 things you need to know about the psychology of curiosity and conversion optimization. Retrieved August 11, 2016, from http://www.jeremysaid.com/blog/the-psychology-of-curiosity-and-conversion-optimization/

Stuart, Z. , Cecelia, M. , Allan, L., & James, L. (2011). Predicting the onset of Alzheimer's disease with a behavioral task. *Alzheimer's & Dementia*. **7**: S549. Retrieved from: doi:10.1016/j.jalz.2011.05.1549

(n.d.). Retrieved from http://www.merriam-webster.com/dictionary/retention

(n.d.). Retrieved from http://study.com/academy/lesson/intrinsic-motivation-in-psychology-definition-examples-factors.html

(n.d.). Exploratory Behavior (definition). Retrieved from http://www.reference.md/files/D005/mD005106.html