

**RELATIONSHIP BETWEEN PEDAGOGICAL PRACTICES AND
OUTCOME OF SCIENTIFIC TRAINING ON BIOLOGICAL EVIDENCE
MANAGEMENT IN NAIROBI COUNTY, KENYA**

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**A Thesis Submitted to the Graduate School in Partial Fulfilment of the
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CHUKA UNIVERSITY

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DECLARATION AND RECOMMENDATION

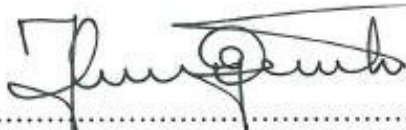
Declaration


This thesis is my original work and has not been presented for an award of a diploma or conferment of degree in any other University or institution.

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DEDICATION

I dedicate this work to my Wife Josephine Mukiri and sons Shem Muthomi and Jayden Mugambi who have been a source of encouragement and inspiration during the writing period.

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I acknowledge the Almighty God for life and good health during the entire research period.

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ABSTRACT

The criminal justice system in Kenya like many developing countries is faced with the challenge of increase in crime rates with low convictions due to weak cases presented in court. This in most cases, has been attributed to minimal, or lack of relevant training in biological evidence management thus inadequate knowledge and skills in the management of biological evidence found at a crime scene. The quality of scientific training received by the Crime Scene Investigators and Crime Scene Management trainees determine the extent to which they effectively manage biological evidence at a crime scene. Empirical literature that could illustrate the link between pedagogical practices and outcome of scientific training on biological evidence management is however limited. This research therefore, focused on the relationship between pedagogical practices and outcome of scientific training on biological evidence management in Nairobi County, Kenya. The researcher sought to establish the content for scientific training on biological evidence management, methods of instruction, instructional resources and assessment methods for scientific training on biological evidence management. The study adopted descriptive research design with a sample size of 132. Participants included 87 Crime Scene Management trainees, 33 Crime Scene Trainers and 12 Quality Control Officers. Stratified and simple random sampling procedure was applied on Biological Evidence Management Trainees and their trainers. Purposive sampling was used to select the Quality Control Officers. Interview schedule was used to collect data from Quality Control Officers and structured questionnaires used for both Biological Evidence Management Trainees and their trainers. A pilot study was conducted at National Police College (B Campus) on 10% of the sample size. Reliability of the instruments was tested using split-half method. Cronbach's Alpha coefficient of 0.825 to 0.965 for Biological Evidence Management Trainees questionnaire was obtained. The reliability coefficient for Trainers' questionnaire ranged from 0.876 to 0.950. The quantitative data was analyzed by use of descriptive and inferential statistics with the aid of Statistical Package for Social Sciences (SPSS) version 25.0. Qualitative data was analyzed thematically and research hypotheses was tested at 95% level of confidence. The study is meant to inform curriculum planners in collaboration with Directorate of criminal investigations on the need of improvement of scientific training on biological evidence management curriculum. The observations of the research are to help the Interior and National Administration ministry on the need to avail and improve the resources required by DCI for Scientific Training. The content was sufficient though there were few lessons allocated thus inadequate coverage of content. Lecture was most preferred implying preference of teacher centered methods. Printed materials were the most preferred instructional resources, however resources, such as CSI simulations were integrated at relatively low rates. Findings from both BEM trainees and trainers indicated that except for practical and oral presentations, there was minimal use of high order formative assessment methods. Enough lessons should be allocated for adequate coverage of content, CSI trainers to use instructional methods and integrate more instructional resources which are learner centered.

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ABBREVIATIONS AND ACRONYMS

CSI:	Crime Scene Investigator
CSM:	Crime Scene Management
DCI:	Directorate of Criminal Investigation
DNA:	Deoxyribonucleic Acid
IRDU:	Institutional Research and Development Unit
KICD:	Kenya Institute of Curriculum Development
KIPPRA:	Kenya Institute for Public Policy, Research and Analysis
KNBS:	Kenya National Bureau of Statistics
NACOSTI:	National Commission for Science, Technology & Innovation
NC:	Nairobi County
NDU-K	National Defense University-Kenya
NPS	National Police Service
NPSC	National Police Service College
ODPP:	Office of the Director of Public Prosecution
QCO:	Quality Control Officer
SPSS:	Statistical Package for Social Sciences
TVET:	Technical, Vocational Education and Training.
UNODC:	United Nations Office on Drugs and Crime

CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

Crime Scene Investigators are usually exposed to scientific training on biological evidence management at the Directorate of Criminal Investigations. Despite of the training, there is a challenge of wrongfully convicted citizens and failure of cases in court due to poor management of the Crime Scenes across the Country. Empirical evidence from Ndinda and Kariuki (2016) shows that 34,218 criminal cases were reported in 2013 to 2016. Out of cases reported, 11,969 were dropped, 16,200 cases were investigated successfully and 4049 cases were convicted. Failure of such cases could be due to mismanagement of biological evidence associated with inadequate scientific training on biological evidence management. Scientific training on biological evidence management focuses on Forensic Crime scene procedures in regard to biological evidence. The forensic crime scene procedures involve activities at the crime scene as well as laboratory analysis which determine failure or success of a case in Court. The activities carried out by Crime Scene Investigators (CSI) at the crime scene as well as in the laboratories include, securing of biological evidence, preservation, selection, labelling, collection, packaging, transportation, storage, analysis of samples and report writing.

The outcome of scientific training on biological evidence management is determined by the extent of knowledge and skills acquired by Crime Scene Management Trainees and Crime Scene Trainers. The outcome being the product or the way a thing turns out due to an act or omission, means that the level of scientific training of Crime Scene Investigators determines the action to be taken. The conduct of Crime Scene Investigators entails the ethics and standard operating procedures which act as a guide in every forensic crime scene procedure (SOP) such as securing, preserving, selecting, labelling, collecting, packaging, transporting, storing and analysis of biological evidence at the crime scene as well as preparing biological evidence reports (Kampen, 2020). Therefore, for proper conduct there is great need of a high-quality scientific training in biological evidence management.

To avoid instances of poorly managed crime scenes, the CSI need adequate skills and should always do the right thing. Acquiring adequate skills and doing it right eliminates incompetence and recklessness which has led to failure of cases in court for conducting inadequate investigations or intentionally failing to submit critical evidence (Kivoi, 2022). Therefore, Crime Scene Investigators should realize that the success of a case is determined by the knowledge and skills acquired during scientific training on handling various evidence and especially the biological evidence which is easily contaminated hence inaccurate results. Through appropriate scientific training the CSI are able to overcome the challenges of poor evidence gathering, collection of wrong or contaminated forensic evidence which results to criminals being set free or even prosecution of innocent members of the public (KIPPRA, 2022).

Identification, collection, labelling, transportation, storage and analysis of biological evidence require a lot of training on skills and knowledge to enhance the success of a case in court. Therefore, training on biological evidence management is considered to be a vital component of an effective Crime Scene Investigation (Herbig & Warchol, 2011). In order for the Crime Scene Investigators to meet the international standards of processing biological evidence, Directorate of Criminal Investigations and National Police Service in entirety must continuously endeavor to train its staff to the highest possible standards of competence (Constitution of Kenya, 2010).

Biological evidence management is both scientific and investigative endeavor which require logical application of scientific methods, logical and creative thinking as well as experience. Since biological evidence management involves intense, intellectual, comprehensive, tedious, and difficult scientific activities, CSIs require thorough training in order to be effective in the practice (Shaler, 2012). During scientific training in biological evidence management CSI gain skills and knowledge through a pedagogical process which involves the use of a curriculum that has specific content, the use of various instructional methods and instructional resources as well as application of assessments methods.

According to Jerry (2016), training is the most basic requirement for proper management of crime scene because Crime Scene Investigators acquire certain skills for efficient performance. This enables CSI to make general observations of the overall crime scene and patterns before focusing on specific evidence. The core aspect of investigators depends on their capability to identify places to collect materials that could provide evidence and in developing patterns to link up evidence and quickly develop an accurate working theory. Specialized training, backed with experience drawn from handling crime scenes plays an important role in building and developing the sufficient skill base required for handling biological evidence found in the most complex crime scenes (Crispino, 2022).

According to Gehl (2017), for investigators to be objective and successful in yielding correct forensic crime scene evidence, they should have an investigative mindset. This investigative mindset cannot be achieved in any other way other than training of the CSIs. Therefore, training of the CSIs is important in ensuring that the evidence collected is accountable. Evidence accountability is dependent on ability and proficiency of those involved in harvesting, packaging, recording, transporting, handing over, storing and examining of the evidence from the scene of crime to law courts (Hormant & Kennedy, 2014). Additionally, Moriarty & Saks (2015) cites that crime scene training encompasses the cautious collection, processing and documentation of evidence.

Training and development of human resource is an important tool in improving the productivity of any organization. Training equips the employees with knowledge and skills as well as increasing their resourcefulness. Moreover, training increases the competency and efficiency of the employees thus increased productivity (Nassazi, 2013). Several studies document positive outcomes in terms of increased productivity of employees as a result of training. Specifically, (Rohan & Madhumita, 2012) argue that for organizations to grow and perform well, employees should be trained on skills such as teamwork, problem-solving, decision making and communication skills which helps in maintaining healthy relationships at the workplace. Research maintains that training is one of the best methods of increasing employees' productivity and also sharing the organizational vision and goals to the human resource.

Globally, training of Crime scene investigators has been an esteemed endeavor. In U.S.A at Penn State Forensic Science students are engaged in an intensive and practical experiences in laboratory studies. Students are exposed to mock cases where they learn about modern crime laboratories and how to prepare forensic reports. In addition, students are equipped with the skills necessary for evidence collection and other crime scene management procedures (Penn State, Eberly College of Science, 2023).

A forensic specialist refers to a professional who has specialized in forensics and has been certified by a credible institution having attained a PhD, masters or bachelor's degree. The forensic specialist has attained various competences such as: giving expert services to ensure that justice prevails, practices forensic sciences in accordance to the laid laws of the area and also contributes to research work in forensics as well as teaching the juniors undertaking forensic sciences training (Denis-Oliveira, 2022).

South Africa has made remarkable achievement in terms of training in analysis of forensic DNA. The trainees are taken through a two-week course on how to work with modern laboratory equipment and technologies such as the Thermofisher in the Africa forensic DNA training school. This training has offered the post graduate students an opportunity to be certified as qualified DNA analysts (Greyling, 2013).

Consequently, Kenya has invested immensely in training and development of its Forensic professionals and especially the Crime Scene Investigators who process the crime scenes across the country. Directorate of Criminal Investigations which deals with Crime Scene Investigations has endeavored to train the Crime scene investigators to the highest qualification (National Police Service Standing Orders, 2018).

Despite the training in Crime Scene Management, crime has been on the rise. Researchers in social and psychological fields have attempted to explain the increased reports on serious crimes. Among the reasons, studies indicated is the minimal or lack of relevant training in biological evidence management and move by perpetrators to cope and thrive amidst increasing vulnerabilities (Treves, 2013). The studies indicated that crime rate is closely tied to the strength of the economy, increased rate being witnessed during economic recessions whereas during more economically favorable

periods the rates have a tendency to fall. Whatever the extent of crime, management of criminal activities is the prerogative of Crime Scene Investigators who carry out various forensic crime scene procedures at the crime scene.

A study carried out by Muthini (2018) at the DCI headquarters in Nairobi on the challenges facing CSIs found that there was an increase in the number of acquittals in the Kenyan law courts. The study attributed this trend to presentation of inconsistent or insufficient evidence by CSIs. Moreover, the study observed that there were more cases of failed prosecutions due to tampered evidence as well as wrongful convictions among other reasons. More specifically, the study focused on establishing the methods that were used in storage and retrieval of evidence and the correlation between the CSIs' level of training and the effectiveness in carrying out successful investigations. The study observed that 31% of respondents indicated inadequate training in crime scene investigation. Further, the study recommended specialized training for crime scene investigators.

Pedagogical practices are activities that support teaching and learning. The actions developed from the planning and systemization of dynamics of learning process to concrete realization of learning are also referred to as pedagogical practices. Pedagogical practices such as subject matter or content, instructional method, assessment methods and various instructional resources used during the teaching process are the independent variables. Pedagogical practices are most critical in any form of training such as scientific training on biological evidence management. Training entails the instructional activities that are offered to the members of staff of a certain organization in order to equip them with knowledge, skills and attitudes and helping them to apply the same in their day-to-day responsibilities in the organization (Dale, 2012). Training which involves instruction and other practices is a key component in developing personnel in any given organization as it aims at equipping staff with skills that meet the standards of the organization. Moreover, training helps the staff to perform their roles effectively, competently and diligently. Armstrong (2012) cites that training is the methodical acquisition of knowledge, skills and attitudes by personnel in any organization that help in improving their effectiveness in their daily tasks. Therefore, pedagogical practices used during training must consider the content

or subject matter of training, the methods of teaching and learning, the instructional resources and assessment methods.

Since proper handling of a crime scene is determined by the quality of scientific training on biological evidence management, the researcher was interested in establishing the relationship between pedagogical practices and outcome of scientific training on biological evidence management in Nairobi County, Kenya. However, studies on pedagogical practices in relation to training on biological evidence management are minimal. Therefore, the study on relationship between pedagogical practices and outcome of biological evidence Management involved, Crime scene management trainees, Crime scene Investigators and Quality Control Officers who served a special role of Crime Scene Investigations different from the previous studies which involved students and teachers. The views of the respondents served as the raw data which was cleaned, coded and analyzed in order to come up with findings to inform the beneficiaries on areas of improvement and areas of further research.

1.2 Statement to the Problem.

In Kenya, just like most developing countries there are reported cases of innocent citizens finding themselves in prison for crimes that they never committed or criminals enjoying their freedom. The innocent citizens have fallen victims of imprisonment due to mismanaged crime scenes especially by mishandling of biological evidence which directly link a suspect or a victim to the Crime Scene. The mis-management of crime scenes resulting to interference or contamination of biological evidence is attributed to lack of adequate knowledge and skills acquired during Scientific Training on Biological Evidence Management. Lack of or inadequate knowledge and skills result to compromised biological evidence hence failure of cases in court.

Since scientific training on biological evidence was conducted in primary, secondary and college levels, the study seeks to fill the knowledge gap that exists in regard to Police training institutions in establishment of the relationship between pedagogical practices and outcome of scientific training on biological evidence management in Nairobi County, Kenya.

1.3 Purpose of the Study

The study purposed to establish the relationship between pedagogical practices and outcome of scientific training on biological evidence management in Nairobi County, Kenya.

1.4 Objectives of the Study

- i. To establish the relationship between content and the outcome of scientific training on biological evidence management in Nairobi County, Kenya
- ii. To determine the relationship between instructional methods and the outcome of scientific training on biological evidence management in Nairobi County, Kenya.
- iii. To establish the relationship between instructional resources and the outcome of scientific training on biological evidence management in Nairobi County, Kenya
- iv. To determine the relationship between assessment methods and the outcome of scientific training on biological evidence management in Nairobi County, Kenya.

1.5 Research Hypotheses

- H₀₁ There is no statistically significant relationship between content and the outcome of scientific training in biological evidence management in Nairobi County, Kenya.
- H₀₂ There is no statistically significant relationship between instructional methods and the outcome of scientific training in biological evidence management in Nairobi County, Kenya.
- H₀₃ There is no statistically significant relationship between instructional resources and the outcome of scientific training in biological evidence management in Nairobi County, Kenya.
- H₀₄ There is no statistically significant relationship between assessment methods and outcome of scientific training in biological evidence management in Nairobi County, Kenya.

1.6 Significance of the Study

Findings are useful in informing the curriculum planners in collaboration with the Directorate of Criminal investigation on the need to improve curriculum for scientific training on biological evidence management. The findings are intended to inform the Ministry of Internal Security and National Administration on the need to avail and improve the instructional resources required by DCI for scientific training on biological evidence management. The findings are to serve as a guide Crime scene management trainer on instructional methods and assessment methods for biological evidence management for enhancement of scientific training on biological evidence management.

1.7 Assumptions of the Study

All the Crime scene management trainees and CSI trainers had undergone a scientific training on biological evidence management and content was adequately covered during the training.

1.8 Scope of the Study

The research aimed at establishing the relationship between pedagogical practices and outcome of scientific training on biological evidence management in Nairobi County, Kenya. The research focused on the content, instructional methods, instructional resources and assessment methods during the scientific training in biological evidence management.

1.9 Limitations of the Study

Restrictions by the institution's administration in acquiring data from the biological evidence management Trainees and their trainers in Nairobi County.

1.10 Operational Definitions of Terms

The following is the definition of terms both conventionally and as adapted for this study.

Assessment Method: This is a way of providing evidence that students' knowledge and learning meets the aims of a course. In this study assessment method is a way of establishing whether what has been learnt by crime scene trainee during biological evidence management subject is the same to what was taught by the crime scene trainers. Some of the assessment methods are; posing questions to trainees during lessons, giving assignments /exercises to trainees at the end of the lesson, conducting of mid-course exams and conducting end of course exams.

Biological Evidence: Includes any substance that contains a person's Deoxyribonucleic Acid (DNA). In this study biological evidence means the evidence of biological nature collected from a crime scene by the crime scene investigators such as blood samples, hair samples, bones, skin cells, bodily fluids and saliva.

Content: Subject matter to be imparted to students. Content can therefore be referred as Subject matter depending on the context. In this study means areas covered during scientific training on biological evidence management which include securing of biological evidence at a crime scene, preservation of biological evidence, selection of biological evidence, labelling, collection, packaging, transportation, storage, analysis of biological evidence and report writing.

Crime Scene Procedures: Crime scene procedures is the investigative process or a progression of activities or steps of evidence gathering. In this study crime scene procedures involves preservation of biological evidence, selection, labelling, collection, packaging, transportation, storage, examination or laboratory analysis of biological evidence and preparation of scientific reports.

Crime scene Means any location that may be associated with a committed crime. In this study crime scene means a place where a crime has taken place which is visited by Crime Scene Investigators in order to carry out forensic crime scene procedures to obtain biological evidence.

Crime Scene Investigator: Is a person in charge of extracting every possible piece of evidence from a particular crime scene. In this study a crime scene investigator is a person who is trained to carry out thorough and careful observation at the crime scene, preserves all pieces of evidence, collect, store where necessary, transports, conducts analysis of samples and make reports to be presented to court.

Evidence Management: Is the administration and control of evidence related to an event so that it can be used to prove the circumstances of the event, and so that this proof can be tested by independent parties with confidence that the evidence provided is the evidence collected related to the event. In this study, evidence management means securing of biological evidence at the crime scene, preservation, selection, labelling, collection, packaging, transportation, storage, analysis of biological evidence and preparation of biological evidence reports.

Forensic: Means the application of scientific methods and techniques to the investigation of crime. Forensics are the scientific tests or techniques used in connection with the detection of crime. In this study forensic means the scientific knowledge and skills received by crime scene investigators during scientific training in biological evidence management. Forensic also means scientific methods or procedures followed or applied at a crime scene.

Instructional Method: These are the methods used by teachers to enable student learning. These strategies are determined partly on subject matter to be taught and partly by nature of the learner. In this study instruction methods comprises of lecture method,

discussion method, demonstration method, use of presentation, practical work and project work method.

Outcome: Means the way a thing turns out or a product of a certain process. In this study an outcome means right or wrong actions at the crime scene which include preservation of biological evidence at the crime scene, selection of the appropriate biological evidence, collection of appropriate biological evidence, correct labelling of biological evidence, proper transportation, proper storage and analysis of biological evidence.

Pedagogical Concepts: Pedagogical practices are activities that support teaching and learning. The actions developed from the planning and systemization of dynamics of learning process to concrete realization of learning are also referred to as pedagogical practices. In this study pedagogical practices includes instructional methods and assessment methods that involve specific subject matter and utilize certain instructional resources.

Training: Training are the teaching and learning activities provided to the human resource or an organization to equip them with skills needed for a certain job. In this study training means transfer of skills and knowledge about crime scene investigation content taught by crime scene trainers using various instruction methods, resources and assessment methods.

CHAPTER TWO

LITERATURE REVIEW

2.1 Outcome of Scientific Training in Biological Evidence Management

The outcome of scientific training in biological evidence management plays a critical role in success of case in court. The knowledge and skills acquired during scientific training by the Crime Scene investigators determines how well or poorly the Crime Scene Investigators handle the biological evidence at a crime scene. The crime scene investigators are trained on biological evidence management during Crime Scene Management Course. During the scientific training in biological evidence management Crime Scene Management trainees are taught on various forensic crime scene procedures. Some of crime scene procedures include; securing of biological evidence at the crime scene, preservation, selection labelling, collection, packaging, transportation, storage, analysis of biological evidence in the laboratories and preparation of reports based on the lab findings (Watson, 2017).

Marietta, (2022) cited that, Crime Scene Investigators look at biological evidence such as blood and body fluid to establish whether a crime took taken place. In addition, Crime scene Investigators gather and document any biological evidence found at a crime scene in order to solve a crime or determine how a crime took place. This kind of investigation also involves the analysis of what investigators collect to ensure the evidence is credible and relevant.

The main duty of the DCI in the Kenyan republic is to investigate crimes committed by individuals in order to find facts in regard to the criminal activity committed. The DCI is obligated to perform its duties as outlined by the Kenyan constitution and other legal frameworks that guide crime scene investigations (Nyakundi 2015). These legal frameworks outline laws such as respect for the human rights as well as international best practices related to crime investigations. There are various procedures that CSIs are expected to follow including; adopting a common method of how they will proceed from one stage of investigation to another, ensuring that the adopted method meets the standards of investigation processes. There should be Consistency and development of conducive work environment in which all CSIs in various specializations are comfortable to work in while upholding professionalism (KNBS, 2016).

In Kenya just like in any other country, CSIs are tasked to investigate crimes whether serious or lesser crimes. The serious crimes include rape, arson, robbery, terrorism, drugs and human trafficking as well as murder while lesser crimes are those that can be investigated in a routine manner by regular officers. During investigations of any crime, CSIs are expected to follow the standard procedures of crime scene management in order to have first- hand information of when, where and how a crime may have been committed (Ndinda & Kariuki, 2016). Nyakundi (2015) cites that every CSI should always have a notebook and a pen in the kit box which is very important as it aids in immediate documentation of how events unfold in the crime scene and at every stage of investigations. The CSIs are encouraged to safely keep the recordings which are later used as exhibits during hearing of cases in courts.

In the Kenyan system, Crime Scene Investigators follow six main steps in investigating criminal activities which might not be the case in biological evidence management (IRDU, 2016). Biological evidence management mostly follow at least ten steps which include securing of a crime scene, preservation, selection, labeling, collection, packaging, transportation, storage, analysis of biological evidence and preparation of reports. Every investigative process starts with securing of the crime scene which is the first stage and proceeds to stages six or ten. The number of stages followed is dependent on the nature of crime under investigation. Some cases can be concluded during any of the stages especially in cases where complaints give false evidence or when the evidence is inadequate to sustain the case through the prosecution process (Okwiri, 2016).

2.1.1 Securing of Biological Evidence at the Crime Scene

Securing the scene of crime can be defined as taking all necessary actions to ensure that the conditions and factors which have the potential of destroying or disturbing biological evidence at the scene of death, abuse or any other crime are stabilized and well regulated (Gehl, 2017). Securing of a crime scene involves either erection of barriers to prevent members of public interfering with crime scene, condoning the crime scene with a crime scene condoning tape, placing individuals at various points to direct anyone approaching the crime scene or use of signs/labels to show direction.

2.1.2 Preservation of Biological Evidence

The main purpose of preserving evidence is to ensure that it is not destroyed, contaminated or lost. To achieve this, the crime scene investigators attending to a case of rape or sexual assault should inform the victim on various things to refrain from until an examination can be completed (Newton, 2013). During rape or sexual assault, the crime scene investigators are required to inform the victim not to take a bath or clean any body part such as the head, hair, mouth and hands. The crime scene investigators should inform the victim to avoid eating, drinking, chewing or smoking. Running or performing any kind of sport activities should be avoided by the victim (Stevens, 2021).

The Crime Scene Investigators should apply the appropriate crime scene search techniques and crime scene evidence detection aids. Various aspects of the crime scene may call for detailed analysis to achieve the full evidential potential. These include and are not limited to blood spatter, glass fracture, burn pattern, and bullet path or trajectory analyses. The number of Crime Scene Investigators should be limited to minimize chances of destruction and contamination of exhibits. Buckleton (2019) cites that when genetic materials are contaminated by other materials such as from the Investigator, DNA analysis may yield incorrect information which can lead to lack of consistent evidence.

For instance, while investigating rape, genetic materials can be contaminated if the victim is abused by several perpetrators, during transportation from the crime scene to the hospital or when medics are performing various body examination. Therefore, investigators are supposed to handle evidence with a lot of caution in order to ensure that there is no cross-contamination of evidences (Butler, 2012). To achieve this, CSIs are advised to work in sterile conditions to prevent microbial contamination. Personal protection equipment which are disposable should be used to ensure safety of evidence for example, gowns, powder-free gloves, masks, or other protective clothing to avoid direct contact with the biological samples. Rooms where sample collection activities are conducted in should be cleaned thoroughly and on regular basis before and after being used. Eating, drinking and smoking are prohibited when handling samples. CSIs are also encouraged not to sneeze, talk or cough during sample collection. The swabs or other samples need to be dried and stored separately, ensuring that they are contact-

free (Kline, 2013). As cited by Ballon (2013) CSIs should change gloves when collecting each sample so as to avoid cross-contamination.

2.1.3 Selection of Biological Evidence

CSIs select objects of interest such as clothes and shoes from scene of crime and take them to a laboratory for forensic analysis by various specialists. As the name suggest, biological evidence is biological in nature either of the perpetrator or the victim for example; saliva, blood, sweat, semen, vaginal fluids and any other bodily fluid. CSIs also check the finger nails of the victim for traces of cells from the criminals' body or epithelial cells of the victim on the genitalia of the perpetrator. Other evidence selected includes botanical substances like wood, pollen and plants found on the items collected or on the bodies of either the victim or the perpetrator (Mitchell, 2014). The crime scene investigators should be aware that biological evidence is selected depending on evidential value. Since what is selected is what is collected, this stage is very important to the crime scene investigators. It is the selected biological evidence that is collected.

2.1.4 Collection of Biological Evidence

Crime Scene Investigators perform the evidence collection process in an orderly manner following the laid -out procedures. For instance, the first step involves walking through or surveying the scene of crime and then determining the sequence to follow while collecting evidence for the specific case (Verdon, 2014). Sequence of collecting evidence varies depending on the location of the crime scene (is it indoors or outdoors), the condition of the evidence (is it delicate or steady) and the weather conditions (Barbaro, 2022). CSIs utilize varied equipment during collection of evidence and they always ensure that they are well sterilized before use. The most commonly used equipment include forceps, wrapping papers, buckets, plastic bags, latex gloves, scalpels, swab sticks, thermometer, simple hand tools, tweezers and cardboard boxes (Stevens, 2021).

The methods and equipment utilized during evidence collection is dependent on the nature of the evidence. For instance, when collecting fluids such as semen for further examination in the lab, cotton-tip swabs are commonly used. One of the challenges that investigators face is the existence of inhibitors (Verdon, 2014) such as dyes found in

denim clothing affects the Polymerase Chain Reaction (PCR) amplification and this compromises the DNA results (Williams, 2012).

Crime Scene Investigators are advised to avoid moving, touching or picking items in a crime scene before they are recorded (Inman and Rudin ,2011). No changes should be made to anything found in the crime scene either by wiping off dirt, grease or blood. CSIs should avoid smelling or cleaning objects which would serve as hints during crime investigations (Moriarty & Saks, 2015). Although biological fluids are seen as the most critical traces of evidence, usually collected using tip-swabs made of cotton, all evidence should be collected. This is because it becomes difficult to collect other possible evidence later since it can be contaminated or cleared which may compromise evidence. Therefore, CSIs should collect all the possible traces of evidence even if not all evidence is taken for laboratory analysis.

Owing to the delicate nature of most exhibits and the vigorous processes and procedures that follow, CSIs should ensure that the procedures and equipment used preserves the original state of the evidence collected. The least intrusive and the most effective evidence recovery technique should be employed. The Crime Scene Investigators also should be aware of what exactly should be collected and the quantity, where to collect the biological evidence, when to collect it and how to collect the biological evidence. Crime Scene Investigators should learn the correct evidence collection process as well as practice use of appropriate equipment for biological evidence collection.

2.1.5 Labeling, Packaging, and Storage of Biological Evidence.

CSIs usually label, pack and store the evidence collected from a scene of crime. This is done with utmost care to avoid losing, damaging or contaminating evidence so as to ensure that the results produced after analysis are correct and reliable. Any other personnel that are involved in this activity should comply to laid standards of evidence custody and are encouraged to follow procedures strictly (Oliveira, 2013). Before packaging the collected evidence, CSIs should dry the evidence to ensure that no damp swabs or materials are packaged. Failure to dry swabs or other evidence may lead to damages of DNA due to bacteria and fungus growth which develop very fast in plastic bags. In instances where it is difficult to dry evidence, then freezing is the best option.

Silva (2015) cites that investigator use paper bags and foldable racks rather than glass containers or plastics because all the remaining humid in the evidence can easily evaporate through the paper.

Investigators should seal evidence individually using self-sealing envelopes. When these envelopes are not available, adhesives such as glue, water or wet gauze should be used and use of saliva should be avoided as it may contaminate the evidence (Vieira, 2015). After sealing, labelling should be done using the victim's name, case number, date and time of collection, type of the sample, evidence number and the body part where the evidence was picked from. If possible, bar codes should be indicated and packages should be signed on the seal to avoid counterfeiting of evidence (Magalhaes, 2015).

After the evidence have been labelled, investigators should store the evidence securely and in appropriate environmental conditions. For instance, kits with DNA samples are kept in the freezer or the refrigerator in order to minimize the growth of bacteria and fungus which alters the structure of the DNA of the samples. The investigators are tasked to transport the sample kits to the laboratory within the shortest time possible (Corte-Real, 2015). It is important to note that whichever means of transport is used, investigators should safeguard the samples to avoid switching or exchanging in between the point of collection and reception in the labs. CSIs and any other professional involved are required to sign at every step of the custody of evidence in order to track details in terms of time, dates and names of the handlers (Silva, 2015).

2.1.6 Analysis of Biological Evidence

Samples that are usually analyzed in the forensic labs include blood, urine, stomach contents, semen, vaginal fluids and vomit. Analysts use presumptive and confirmatory tests to determine the nature of samples in regard to DNA. However, DNA analysis is only applicable for biological samples. Bodily fluids that have no nuclear cells like tears, serum and sweat cannot be analyzed using DNA. The findings after analysis are critical in comparing and confirming unknown sources where the samples were collected in the investigation process (Maloney, 2014). On the other hand, the process of detecting, identifying and quantifying toxic substances and interpreting results is

very critical in solving criminal cases such as cases of poisoning, death and drug abuse cases (Housman, 2014).

Histopathology is the process of examining tissue samples obtained during biopsy of post-mortem. However, the tissue is prepared in a complex process before examination by specialists with the aid of a microscope. During this analysis, the change in the cells can be seen clearly and the findings are very relevant during crime investigation (Gardner, 2014). Bones and other body remain can also be analyzed using histopathology in determining if the bones are of a human or an animal, determining gender, and approximating height and age of the victims. This analysis also helps in determining whether death was caused by injuries on the bones (Maloney, 2014). Analysts involved should have an awareness of the limits of lab analysis and also the effects of contaminating or degrading any evidence.

2.1.7 Biological Evidence Reports

Murray et al (2013) conducted a study on how to use science-writing method in order to foster students reporting skills in biological sciences among college students. The study assessed how science-writing method impacted on the students' capabilities of drawing findings as well reporting through appropriate writings. The participants were given the same writing tasks on the results of lab analysis. One group followed the science-writing method in reporting while the other group reported following the regular report writing. The reports were assessed by 4 assessors who had no knowledge of the new and regular model. The students who followed the science-writing model had higher scores than those who reported in regular writing. The study therefore concluded that students who were reporting using science-writing method performed better and this asserted the claim that this approach improves logical report writing which makes drawing of conclusions easier and more accurate.

2.2 Training of Crime Scene Investigators

In 2018, Julian, Kelty, and Robertson noted that on crime scene investigations, the USA criminal justice departments direct that, every aspect of a crime scene should be handled by a relatively trained technician certified by the FBI. This imply that a single crime may require several professionals. For complicated cases, various professionals with

varied specializations are engaged. In carrying out investigation and evidence collection at the crime scene, investigators need to be aware through training that each piece of evidence collected at the scene is part of a big puzzle and there hardly is an unconnected piece.

Braga, Ataurchan, and Barao (2019) observed that crime scene requires immediate and careful management by investigators who have been trained thoroughly to minimize loss or alteration of evidence. The researchers cited the case of Monica Mathison in Fursternberg in which the officers who responded to the case first went to the scene of crime(burglary) and since they failed to adhere to Standard Operating Procedures (SOP) they were unable to collect sufficient evidence which led to the withdrawal of the case. They officers were not properly trained in handling crime scene and this led to unsuccessful investigative process. and lack of proper training. Proper training in Crime Scene Investigation thus offers a guide on how to manage the available tools for efficient processing and collect biological evidence. The study highlighted the case of This study covered lack of proper training and failure to adhere to standard operating procedures in general terms in Germany. In regard to training of crime scene investigators, the researcher focused on scientific training in biological evidence management and specifically on subject matter, instructional methods, assessment methods and resources for teaching and learning available for the training of crime scene investigators in Kenya.

MarylN and Miller (2017) argued that for efficient crime scene management, there are some things to be considered which are fundamental for successful handling and managing of crime scenes. The researchers cited that these basic factors included; appropriate training of CSIs, provision of adequate and effective equipment and ensuring that CSIs are given a healthy working condition devoid of any source of interference with a strengthened and functioning legal framework to direct and dictate the process of crime scene management. For proper development of capacity in crime scene investigators, the study emphasized that providing an ideal working environment and proper perks is not a surety until it is coupled with appropriate training, professionalism and competency of the CSIs.

Training should go further to acquaint the investigators with necessary information about forensic science, the justice system, nature of evidence and evidence collection, standard operating procedures, chain of custody and witness interviews and interrogation techniques. Though this study covers the variables of interest to the study such as training, it is more of general investigation training and not specific on scientific training biological evidence management on areas of content, instruction methods, instructional resources and assessment methods.

United Nations Office on drugs and crime (UNODC) conducted an online training in 2021 on management of evidence and crime scenes. The study involved 20 experts and it was done in two days. The aim of the training was to develop the expert's awareness of forensic examination processes and the benefits of multi-disciplinary approach in investigative activities (Keltly et al., 2018). The training focused on analytical methods adopted in identifying and quantifying drugs and poison in tissues and body fluids. The study found out that unreliable results in the work of forensic laboratories may lead to false interpretations and conclusions and consequently mislead the investigation and damage the professional reputation of the laboratory thus the need of appropriate personnel training. The training was successful in strengthening the experts' knowledge in international best practices in managing crime scenes and evidence (Robertson, 2018). The study focused on analytical methods to identify and quantify drugs in general terms without narrowing down to specific areas of content for scientific training, methods of teaching and learning, assessment methods used during the analytical methods training and the resources which will be covered in this study.

Aluvaala (2020) studied on the training of DNA analysts in Africa with a particular interest in Kenya. The study observed that African countries lagged behind in adopting new DNA analysis technologies despite the explosions of technologies around the world in regard to DNA analysis. The researcher further noted that though the African governments have made big investments in building laboratories and acquiring some modern technologies, there still exist a gap in terms of adequacy of trained personal. Therefore, the states have not benefitted fully from these investments yet. In South Africa, biological samples were mishandled in a case of murder. The crime scene investigators mishandled biological samples including a ballistics expert who handled

the murder weapon without gloves (Willock, 2018). This study focused on the number of forensic laboratories constructed in Africa and equipping of the same and lack of adequate training. The study did not cover scientific training despite of crime scene investigators having and mishandled biological samples in South Africa and slow uptake of forensic DNA testing. The research will therefore, focus on the scientific training in biological evidence management with interest on content, instruction methods, assessment methods and other resources in the Kenyan perspective.

Muriuki (2022) carried out a study on the capability of DCI departments in Crime Scene Management as case study of Kajiado North Sub-County, Kenya. The study examined the level of training of DCI officers in general as well as how adequate were the technological resources that are used In crime scene management. It was found out that most of the officers had attended some form of formal training concerning crime scene management. Of those who had attended formal pieces of training, most of them received it before joining their current positions. The study recommended that all officers involved in crime scene management should be trained regularly so that they can be updated with the ever-changing world. The study found that most of those who had formal training had been trained locally, with the training taking between one week and one month. It was found out that integration of technology and practical lessons were some of the areas that were missing in training.

According to a study by Manasseh (2021) on the influence of specialized training on the performance of criminal investigation officers in Nakuru County, Kenya, noted that, specialized training was vital in improvement of Crime Scene Investigator's performance. In 2016, a Commission was formed to review the National Police Service Curriculum to align the specialized training for Directorate of Criminal Investigation in the country to the current police requirements. The findings informed the Commission on the need to segregate additional budget for the purchase of modern and state of the art investigative equipment and the need to institute very harsh and stringent measures to deal with those senior officers perpetuating corruption. The focus will be on subject matter for biological evidence management scientific training, instruction methods and assessment methods for biological evidence management scientific training which were not covered in the study.

There were various ways in which CSI are trained on biological evidence management. These include pre-service, in-service and on-the-job training. Pre-service refers to the training that is undertaken by an individual before joining the service (Marangu, 2014). Police officers from both Kenya police and Administration police undergo a basic crime scene management course during their basic recruits' course at National police Service College, Kiganjo and National Police Service College, Embakasi respectively. Later in their career, the officers with science related courses join the Directorate of Criminal Investigation in various specialized forensic sections. At the sections the officers apply the basic skills learnt before they are subjected to an advanced Crime Scene Management course.

In-service training refers to both formal and informal learning activities that are work related offered to employees often organized by the employers with the aim of improving productivity and effectiveness of the human resource (Smith, 2013). The crime scene investigators are usually taken for an advanced crime scene management training at the Directorate of Criminal Investigation Academy for a period of six or less period of time after which they undergo other specialized courses both locally and internationally.

On-the-job training are practical activities offered to employees to help in acquisition of new skills that are required for the job in a work place. It is mostly done to help employees to learn how to operate specific often new equipment in the work place. Some of the crime investigators who move to specialized units within DCI undergo on-the-job training before they are taken for any specialized training either locally or internationally. The Crime Scene Investigators learn how to use various equipment when they attend crime scenes in company of the trained Crime Scene Investigators.

2.3 Pedagogical Practices in Scientific Training on Biological Evidence Management.

There are four pedagogical practices discussed below which include content, instructional methods, instructional resources and assessment methods.

2.3.1 Content and Scientific Training on Biological Evidence Management

Biological evidence management scientific training is based on knowledge and skills acquired on various procedures followed at crime scene. Crime scene procedures range from securing of the crime scene, preservation of biological evidence, selection of biological evidence, collection of biological evidence, labelling, sealing, packaging, transportation, storage and analysis of biological which should comply with the laid-out steps of custody (Magalhaes, 2015). These procedures form the content of training. The Crime Scene Investigators need to gain adequate knowledge on these content areas and all pedagogical activities are focused on achievement of learning of the appropriate content.

When suspected biological evidence is identified, a sample is collected for biological analysis or the entire item is collected (Baber, 2022). During the collection of items from the scene, marks should be made to indicate the area where the items or samples were found with a Sharpie or other markers. Marks made include drawing lines, arrows or circles to indicate the exact position of the samples or items. There should be appropriate documentation of notes showing the location of stains, sizes of the stains, and any light source used during the location of stains. (Butler, 2022).

Physical evidence can be any solid, liquid or semi-solid materials that be used as during court cases in determination of cases (Gaensslen et al., 2017). At the crime scene there can be presence of transient evidences such as blood meaning that the evidence is temporary and can dry up. For such kind of evidence, CSIs should record the observations as soon as possible (Miller, 2013). There is also another type of evidence known as transfer or trace evidence. This is produced during physical contact of objects and persons such as hairs, bodily fluids, drugs, blood and the soil (Pyrek, 2014). Therefore, investigators should handle and preserve evidence properly in regard to the required legal and scientific standards to ensure that it is not contaminated in for analysis (National Medico Legal Review Panel, 2017). There is a great need to ensure that the physical evidence is well preserved to avoid contamination by either the victims, suspects or the crime scene investigators for example, whereby the crime scene investigators handle some items without gloves or they handle several items with the same pair of gloves.

According to Braswell (2014), there are some biological evidences that require visualization using chemical enhancements such as luminal or alternative sources of light since they are difficult to identify with naked eyes. For instance, luminal can be used in identifying blood samples as it causes a chemical reaction with blood which results to production of a glow or a luminescence. However, for one to see the chemical reaction, the process should be done in a dark area. Moreover, investigators can use the technique of filtered photography which is used in documenting evidence in a crime scene using alternative sources of light such as luma-lite or a polirary light (Bruna, 2012). The alternative sources of light are transported to the scene of crime and are used to search for body fluids such as stains of semen and saliva, inks, dyes, powders or any other substance that may react during the exposure to the alternative source of light (Hewson, 2013). In order to identify biological evidence, the crime scene investigators need to be fully conversant with various techniques of identification and collection. It is therefore necessary for CSI to acquire necessary knowledge and skills on procedures involved at the crime scene containing biological evidence in order for them to handle the biological evidence appropriately. The training should therefore be based on these content areas.

Previously, studies have attempted to illustrate the relationship between content and processes of training. For instance, Catalano et al (2019), assessed the influence of teachers' expertise in sciences on their self -efficacy during teaching. One of the study objectives was to compare teachers who were in STEM programs with those in lower levels of education. The respondents in this study were 27 pre-service and 82 in-service teachers. The study findings indicated that teachers with low knowledge of science content had low self-efficacy in sciences. The study also observed that teachers who were in pre-service category had high levels of self-efficacy as compared to their counterparts who were in-serviced. The researcher recommended that teachers should seek to have more understanding of science content in order to be sufficiently prepared while teaching science subjects. On the contrary, teachers who believed that they have higher levels of self-efficacy in teaching sciences, they seemed not to be aware that they needed continuous training in order to improve in areas where they were weak and also because of the changing nature of science content.

A study by Diwa et al. (2023) investigated how school location affected teachers' effectiveness in content mastery for instruction in the classrooms in mathematics Calabar Education Zone, Nigeria. Survey research design was adopted for the study. The study used census sampling in selection of the respondents. Questionnaires were used as tools of collecting data. The study was guided by hypothesis which were tested using population t-test and independent t-test analysis. Findings of the study indicated that the location of the school influenced teaching effectiveness in relation to mastery of content in math subject and more so during the instructional process.

Therefore, studies on content for scientific training have been conducted in teacher training, primary and secondary schools but minimal research have been carried out in a police training institute on content in relation to scientific training thus the need of this study for purpose of filling the knowledge gap that exists in regard to the relationship between pedagogical concepts and outcome of scientific training on biological evidence management in Nairobi County, Kenya.

2.3.2 Instructional Methods and Scientific Training in Biological Evidence Management

Teaching methods are the techniques employed during instruction in order to achieve the instructional objectives. They can also be defined as the principles that guide teachers while instructing learners in any level. The principles that guide teachers include: student self-perception matters, baseline assessments, different influences on students' knowledge, learning based on context, practice matters and the importance of feedback (Acodo & Conrad, 2014). Teaching methods are mainly chosen depending on the nature of the content to be taught as well as the nature of the learners (Jalongo, 2010). Various methods of teaching assist learners in mastery of the subject matter in a certain discipline and how to apply the acquired knowledge in specific situations (Hirsh, 2010). In addition, while teachers are choosing a certain method of teaching, they are usually guided by the classroom demographics, school's mission and vision, the country's philosophy of education and the nature of the content to be Also, teachers should identify which teaching methods will properly support a particular learning outcome.

A study by Shukla (2021) on systematic approach of teaching and learning of forensic science for interdisciplinary students titled; a step towards renovating the forensic education system. Six pedagogies were adopted during undergraduate course in forensics which focused in developing creative thinking, logical and critical thinking, practical-based learning and development of research aptitudes among the students. (Ahrenkiel, 2014). The study attempted to reduce the gap between theoretical and practical education in forensics. The researcher adopted methods such as inquiry (interaction/discussion) based learning where learners are engaged in exploring possibilities in real world through inquisitive learning as well as experiential and problem-solving activities (Leonhard, 2014); Observation-based learning which is the process of learning by watching the behaviors of others , experiment-based learning which is learning by doing, problem-based learning where students work in groups to solve open-ended problems, case-based learning where students are engaged in discussion of specific scenarios that resemble or typically are real-world examples and project-based learning. Other methods could be used for training the crime scene investigators such as blended learning, brainstorming, and use of presentation, lecture method of learning, discussion method of learning and demonstration method of learning.

A capacity development training held by United Nations Office on Drugs and Crime (UNODC) in Vienna cites that ‘blended learning’ has become a common practice in education. Such a teaching method can be used to train Crime Scene Investigators in Kenya. This method of teaching enables the Crime Scene Investigators to meet their trainers in class for face-to-face sessions and they are also capable of accessing content sent by their trainers online (Thomas, 2017). Therefore, the method of learning is very crucial since the crime scene trainers share their experiences with the crime scene trainees.

A workshop held in April 2018 on training of officers held in Peshawar, Pakistan on “Illicit drug trafficking and diversion of precursors” employed the ‘blended learning approach’. This approach included methods such as oral and group presentations and e-learning modules. The workshop was successful since the participants acquired skills on how to control illicit drugs trafficking while still adhering to the international

guidelines. In addition to lectures given by experts during the training workshop were helpful to the participants as they acquired new skills of identifying and interdicting drugs (Dziuban, 2018). The study focused on blended, lecture, and presentation methods of teaching and learning which are variables of interest though did not cover discussion, demonstration and brainstorming which will be of focus in this study.

2.3.2.1 Lecture Method for Instruction

Lecture method is regarded to be the oldest method of teaching. Lecture involves giving oral explanations of a certain concept to the learners. The role of the instructor is to clarify content by use of voice intonations, body movements, gestures, facial expressions and at times use of materials such as the chalkboard. The main aim of this method is to emphasize on the subject matter being presented. Lecture is founded on idealism philosophy. Instructors are more actively engaged in learning more than the learners who act as mere recipients of knowledge though the teacher may ask questions during the lesson to maintain the learner's attention (Sharma, 2020). The advantages of this method include; it is economical, it is suitable for large population of learners, it is time-saving and help in covering a wider scope of the content. In addition, teachers can use it without prior arrangement and it is very simple to use. Lecture method train learners on how to be attentive listeners. Lecture also provides learners with opportunities where they can ask the teacher to clarify on some concept during the lesson. Lectures also provide an interaction between the learners and the teachers thus providing a personal touch in instruction (Kaur, 2020).

The lecture method has limitations such as its failure to consider individual differences of the learners. It also acts against the principle of learning that cites that learning should be activity-based. Since the learners are passive during the lessons, they do not acquire reasoning skills and the teacher becomes the center of knowledge thus the lessons tend to be monotonous. It is notable that this method is the most commonly used across all levels despite the various limitations. However, lectures can improve to become more engaging and interesting by encouraging learners to ask and answer questions, utilization of various instructional materials, organizing the content in a logical and spiral manner as well as ensuring the lessons are as interactive as possible (Sharma, 2020).

Rehncy (2020), observed that lecture method is still the most commonly used instructional technique across all levels of learning in schools. Instructors use this method to impart knowledge, skills and attitudes in various disciplines. There is minimal utilization of instructional resources. Lecture method in training enable the crime scene trainers to share knowledge and skills with their trainees when they have limited time especially when the time allocated for a course is not sufficient (Kaur, 2020).

2.3.2.2 Group Discussion Method of Instruction

Discussion method is a key component of any instructional setting since it gives learners an opportunity to share opinions and perceptions about a certain topic (Emendu, 2013). Udogu (2013) cites that instructors can use discussions at the beginning of at the lesson to assess what the learners already know about the topic or at the end of a lesson to assess what the learners have understood about the topic taught. This method allows sharing of ideas which promotes activity-based learning especially when all the members of the group participate actively. Fernando (2017), highlighted some of the merits of discussion methods such as; learners are able to understand the concepts in a better way, there is enhanced motivation of learners since they are more involved, it promotes social skills such as leadership skills, and promotes cooperation among students. Discussions also help in acquisition of organizational skills as well as the ability to present ideas logically. Marikar (2017) noted that discussion method has some disadvantages such as; it is only effective when the learners are few, it consumes a lot of time, and if the instructor does not handle the groups well, the extroverted students become dominating in groups discriminating the introverts.

Discussion method used in the training of biological evidence management enable the crime scene investigators to have a deep understanding of the biological evidence management subject matter. This is as a result of crime scene investigators remaining motivated and much involved throughout the lesson. The group discussion method can be used by the crime scene trainees especially when there is a difficult concept that is not easily understood by all the learners. Group discussion can take place during the lesson or after the lesson.

2.3.2.3 Demonstration Method of Instruction during Biological Evidence Management Scientific Training

Demonstration can be defined as an exhibition or a practical display of a process with the aim of showing or pointing out how certain principles operate. Utilization of this method requires the instructor to engage learners in practical tasks at the end of the demonstration so that procedures can be reinforced in the learners' minds. This method is an effective tool especially in practical-based subjects such as sciences as it presents abstract concepts in a concrete and observable manner (Ramadhan, 2017). Demonstrations help in promoting the students' attention during the lesson as they actively engaged in learning. Since demonstrations present content in form of real experiences, learners' interest is sustained and this leads to better retention of concepts. However, this method is costly and consumes a lot of time. The teacher also has to prepare equipment before the lesson and also carry out rehearsals before the actual presentation in class. Adequate instructional resources are required for effective demonstrations in order to allow all learners to participate in practical sessions right after the teacher have demonstrated the procedures (Kitti, 2014). Demonstration method of teaching offers the crime scene investigators with the real experiences of what they expect to find in the field and it becomes interesting to the trainees thus promoting attention and retention during class work.

2.3.2.4 Use of Presentation during the Scientific Training in Biological Evidence Management

Presentation method entails involvement of students in carrying out research and presentation of findings and opinions to others during lessons. Students are expected to examine perceptions, ideas and opinions in order to develop new knowledge with the teacher acting as a supervisor (Farabi, 2017). This method helps learners in mastering concepts and skills and it is very instrumental in promoting self-confidence among the learners. In addition, presentations instill the skill of self-driven research of topics under study which promotes the virtue of learning to learn in learners (Hassavand, 2017). Use of presentations as an instructional method would enable the crime scene investigators to master the subject matter content and it increases confidence amongst the crime scene investigators during training. The crime scene trainees get an opportunity to learn from one another since every trainee does a lot of research for purpose of presentation.

According to Gorjian (2017), no method of teaching is sufficient on its own during instruction. It is therefore advisable to combine two or more methods in order to maximize the outcomes of the instructional process. The methods of teaching and learning discussed can all be applied during training in biological evidence management since there is need of instructors who take the teacher or supervisor role and the crime scene investigators take the role of pupils or students. For effective training in biological evidence, the appropriate teaching and learning method should be used. When teachers use inappropriate methods of instruction, it becomes difficult to achieve the instructional objectives which may lead to insufficient learning resulting to incompetent workforce.

2.3.2.5 Practical Work

Miller defined practical activities as instructional activities used in science instruction where learners manipulate equipment and materials with the aim of having insights in a particular topic. Learners carry out practical as individuals or in groups as guided by the teacher (Grin, 2022). Practical work gives students an opportunity to have first-hand and direct experiences while investigating a certain phenomenon (National Strategies, 2008).

The primary activities are basically hands-on including investigating a phenomenon, carrying out laboratory procedures and conducting field work. These activities promote acquisition of laboratory practical skills which enable the students to have a better comprehension of scientific principles and processes (Ferreira, 2014). The other set of activities follow the cited processes. They include analysis of data analysis collected from the field in the labs mainly with the aid of ICT devices. Therefore, the activities are not hands-on but focusses more in cleaning and coding for further analysis and later making conclusions of the findings (Kidman, 2012).

Previously, studies have attempted to illustrate the relationship between instructional methods and process of training. A study by Abdi and Ali (2014) in Spain on: The effect of Inquiry-Based Learning Method on Students' Academic Achievement in Science Course, investigated the influence of inquiry-based learning method on learners' performance in science subjects. The study adopted purposive sampling to select 40

class 5 pupils from two different classes. One group of pupils which was the experimental group was taught using the new method while the other group was taught using the conventional method. After a period of 8 weeks, the two groups were pre- and post-tested using 30 set of quizzes. ANOVA was used in data analysis. The researcher found that pupils who were taught using inquiry-based methods performed better in the test than the pupils who were taught using the conventional method.

A study was conducted by Meremikwu et al. (2023) in Nigeria on the influence of using contemporary teaching methods on the performance of students in mathematics. The researcher noted that students who were taught in mother tongue, using modern teaching methods (discovery method) and those who adopted modern technology performed better than their counterparts. The study gave various recommendations including recommending the education ministry to organize in-service training for junior secondary teachers to acquire modern strategies of teaching as well to have competency in using modern technology. In addition, the study noted that there was need for provision of modern-equipped maths labs for the secondary school students.

Out of the previous studies, there is none which was conducted in a police training institution in regard to concept of pedagogy. Most of the studies on instruction methods were carried out in primary and secondary school set-up thus the need of such a study in a police training institution on the relationship between pedagogical concepts and outcome of scientific training on biological evidence management in Nairobi County, Kenya.

2.3.3 Instructional Resources and Scientific Training in Biological Evidence

Teaching and learning resources including classrooms, laboratories, desks, chairs, computers, laptops, teaching aids, textbooks, trainers among others are very important in the effectiveness of the instructional process. Instructional materials assist in achievement of educational objectives such as understanding the outcome of forensic crime scene procedures by crime scene investigators during biological evidence management training. Availability and adequacy of instructional resources make training effective as they sustain the trainee's interest, provide meaningful experiences and promote practical work. Therefore, instructional resources should be of good

quality and sufficient in academies for efficient training such as in biological evidence management. A study carried out by Momoh (2010) in West Africa on the impact of teaching materials on learners' achievement in summative examinations found out that use of resources during instruction greatly affected achievement in ten subjects. The researcher therefore concluded that utilization of teaching materials during lessons improved the achievement of learners even during the final examinations.

Studies have shown that use of teaching and learning materials during the instructional process assist the teacher illustrating abstract concepts thus making it easier for students to understand. Materials also provide hands-on activities which allow multi-sensorial learning and also increases learner's engagement in class. They also help in overcoming barriers where real materials may not be accessible, increase learners' scope of knowledge in the subject as well as sustaining attention in class work. Moreover, instructional materials minimize monotony during lessons where the teacher talks throughout the lesson and also discourages memorization of facts which results to better retention of content learnt. In a class where materials are available and adequate, learners are active participants in the instructional process and this reduces indiscipline cases which are associated with monotonous lectures containing mostly abstract contents (Falade, 2016).

A survey done and reported by the Saturday Nation Kenya on February 4, 2017 presented findings about the status of Kenyan schools. The report indicated that most schools had been neglected in terms of infrastructure and learners were learning in unconducive environment including under the trees. Pupils sat on stones, floors and logs. Teachers were demotivated and had to keep up with the poor states of most public schools especially in rural areas and urban slums. Most schools in slums were characterized with dumpsites near the schools, floors with potholes, open sewers passing in schools, crumbly ceilings and dilapidated walls with huge cracks. This survey was conducted over a period of one week and it focused more on the schools' infrastructure. The focus of this study was on equipment and furniture in forensic biology laboratory, equipment and furniture in forensic chemistry laboratory and many all-other forensic sections under the study (Murage et al.,2015)

While assessing the success of free primary education in Kenya, Luvega (2017) observed that inadequate and/or lack of school infrastructure were the main hindrances in accessing quality educational services. The study focused on various types of infrastructure such as chairs, tables, classes, desks, lavatories and play grounds. In schools where most of these materials were lacking, learners performed poorly since the environment was not supportive of the instructional process. The study was on same problem can result to crime scene investigators not having a conducive environment of study hence failure to grasp the skills and knowledge adequately.

Lyons (2012) asserts that education is a multifaceted endeavor where learner's physical conditions and motivational levels are tested. Over the years, educators have assumed that content and instructional methods are all that counts during instruction. However, this notion is changing as it becomes more evident through various studies and experience that the physical conditions indeed influence learning. The study focused on infrastructure in primary schools in relation to conducive environment and this study will focus on infrastructure and relation to conducive environment during scientific training in crime scene investigation.

According to Earthman (2014), good performance in education is influenced by various factors that ensures that learners are comfortable such as good ventilation of classrooms, reduced or no noise in the school environment, less distractive drawings near the school and comfortable learner-friendly furniture. Several studies have reviewed how the quality of school buildings correlates with educational achievement. There was more focus on how buildings designs and conditions relates to learners comfort in terms of lighting, ventilation, noise control, and adequate space to allow group work and ease of movement in the classrooms.

Research by (Schneider, 2012) observed that the poor design and bad conditions of school buildings can steer students to be violent, drug abusers, truant, brutes, absentees which may lead to disciplinary actions including suspension form the school. Fisher (2016) observed that poorly done infrastructure had negative effects on the learners' performance as well as that of teachers. For instance, teachers' lie at work was highly affected by poor ventilation, lack of sufficient light even during the day, noise near the

classes and danger of crumbling ceilings and walls. In such poor conditions, the study established that most teachers are unsettled and less motivated and there was high rate of turn over as teachers left the schools in search of better conditions in other schools.

The instructional resources/materials and the related factors can affect the crime scene trainees and their trainers. For instance, the unavailability of the resources may result to poor teaching-learning environment for both the trainees and the trainers hence inadequate acquisition of knowledge and skills. The focus will be on resources and material used by DCI during scientific training in biological evidence management.

A study was conducted by Ekon and Sombo (2023) on the influence of locally available instructional materials on students' performance in biology subject. The study was guided by 2 research questions and 2 research hypotheses. A pretest, posttest non-equivalent quasi-experimental research design was used in the study. The study sample comprised of 75 students. A test titled Senior Secondary School Biology Achievement Test (SSSBAT) was given to the students. Data was analyzed using Analysis of Covariance (ANOVA). The study found that there is a significant influence of locally available instructional materials on biology students' academic achievement. It was recommended that biology teachers should source for and utilize locally available materials during biology lessons as they stimulate students' critical thinking/imaginative skills as well as help in reducing subject abstraction phobia, thus, improving biology students' academic achievement.

According to research by Arop et al. (2015) on the impact of use of teaching and learning resources on learning of sciences in junior high schools indicated that utilization of materials led to improvement in science-based subjects. One of the researcher's recommendations is that teachers were encouraged to avail adequate and appropriate resources and also to improvise from readily available materials for efficient instructional processes and mastery of content in science. Sabina Amos et al. carried out a study in Ghana on the influence of using teaching and learning materials during biology training in colleges. The researchers observed that resources improved the students' performance and sustained their attention during the lessons. The

instructors also reported that materials were useful in assessing the students' and also helped in lesson delivery.

The cited studies were related to the current research but there is need to note that most of those studies were conducted in primary school, secondary school and teaching college set-up where lack of instructional resources had various implications. In Kenya there is no study which have been conducted in a police training institution, thus the need of this study for the purpose of filling the knowledge gap that exists in regard to relationship between pedagogical concepts and outcome of scientific training on biological evidence management in Nairobi, Kenya.

2.3.4 Assessment Methods for Scientific Training on Biological Evidence Management

Assessment is the systematic process of documenting, in measurable terms, the knowledge, skills, attitudes and beliefs of the learner (Poehner, 2017). The main purpose of assessing students is to evaluate how effective a method of teaching is, measuring how learners have applied new knowledge acquired and assessing whether learning objectives have been achieved. The feedback after assessing learning help teachers in reviewing the methods, materials and content as well as other prevailing factors that may affect performance. On the other hand, tests are useful in examining the student's knowledge of some concepts in order to evaluate what the student have learnt. There are two main types of assessment in education including formative and summative assessment.

During formative assessment, the teacher assesses learning and the objective of this assessment is to check if the learner is comprehending what has been learnt. It provides immediate feedback to the teacher and helps in improving the instructional process in terms of teaching techniques and resources used (Dodge, 2017). Techniques used in assessing learners include projects, practical activities, question and answer sessions, continuous assessment tests, quizzes and random tests.

Summative assessment focuses on determining the achievement of learning outcomes especially as the end of the instructional process, program, grade or level of education. The teacher evaluates whether there is change in behavior in the learners in relation to their entry behavior and whether the learner has acquired knowledge, skills and attitudes (Fisher, 2016). While assessing students, teachers are encouraged to evaluate whether the learner have acquired the techniques of analyzing, synthesizing, testing of hypothesis, critical thinking and problem-solving which are crucial in developing students who are autonomous and eager to learn. On the contrary, when teachers assess content retained over the period of learning, students tend to memorize and rote learn for the purposes of examinations (Gibbs, 2010). Techniques used in summative assessment include; examinations, term papers, essays, presentations, group work and practical examinations.

Question and answer method of assessment usually ask open-ended questions which requires short answers. This method is mostly used in testing facts about a concept and marking is done depending on the answers given. Questions and answer activities help learners in acquiring the skills needed to solve problems encountered in daily life especially when in situations that require very fast responses. Klemmer (2014) asserts that most life situations are open-ended and require short and instant answers. Consequently, using this technique while assessing learners help in acquisition of reasoning and logical-thinking skills which may not be fostered by other methods (Hift, 2014). Another merit of this technique is that responses are marked instantly unlike in other assessments where teachers use a lot of time in marking. Teachers are encouraged to be fair while administering this assessment while still evaluating outcomes of learning in a particular topic.

Essay is another form of examination which involves lengthy writings on a particular topic. Students can be engaged in reviewing literature, carrying out case studies, writing reflections and preparing reports. Essays mostly evaluate the learners' abilities in analysis, evaluation and synthesis of various theories and concepts based on the evidence provided. According to Winter (2013), essays are efficient to mark since they can be marked by varied examiners and moderators. Term paper work technique entails giving several assignments where learners are supposed to work on through the term

and compile the paper at end. Some teachers group students to work on a specific topic and this fosters acquisition of social skills such as cooperation. Term papers ensures regular learning as learners have to keep on researching about the topic and this reduces memorization and last-minute rush like in the case of examinations.

Another assessment technique is oral presentations which allows learners to show their communication abilities such as fluency, clarity and coherence. (Thalluri & Penman, 2013). Teachers can assess students' presentations through various activities such as panel sessions, role-playing, holding debates and mock trials. During these activities, student's confidence is boosted and verbal skills are harnessed (Zickovic, 2014). Presentations are also enjoyable and motivates learners unlike other methods of assessments.

In addition, teachers can use group projects while assessing learners. Group work promotes team spirit among learners and also saves time for the teacher. Group projects also assist introverted learners since the groups are smaller and this helps in developing social skills such as leadership. This method give room for peer-assessment and objective critiquing of each other's work hence improved collaborative learning (Gaur & Gupta, 2013). Moreover, it is in groups that students learn skills of managing time, turn-taking and resolving conflicts. Students also learn to accommodate differences from other people as well as negotiation skills in order to complete the tasks give.

Kibirige and Lesiba (2017) carried out a study in South Africa to compare the actual and ideal practices of assessment as outlined in education policies. The researchers purposively selected 5 grade 9 assessors across the different levels of schools in terms of performance. Findings of the study indicated that teachers deviated from the ideal assessment practices in actual assessment exercises in class. Consistent to these findings, Oyinloye et al. (2019) in a study on the impact of assessment for learning on learner performance in Life Science found that learners who were taught using the approach of being assessed for learning performed better than those taught using the regular instructional methods.

Roseline and Akintunde, (2023) carried out a study on in Nigeria using the expo facto design. The findings indicated that in-service training programs for mathematics teachers led to improvement in performance of students in the subject. The researchers recommended that the government should increase the in-service training among secondary school teachers on modern methods of teaching across the schools in Nigeria to promote high performance in mathematics among secondary school students.

Most of the above studies were carried out in secondary school set-up where there are various implications that resulted from the studies especially in the area of Policy statements. In two of the studies the reliability co-efficient was 0.76 and 0.77 respectively. Some studies applied expo facto research design, quasi-experimental and descriptive survey. The descriptive survey was applied in a study conducted in a secondary school thus the need to carry out a study using a similar design in a police training institution on the relationship between pedagogical practices and scientific training on Biological Evidence Management in Nairobi County, Kenya.

2.4 Theoretical Framework

The research was guided by Jerome Bruner's theory of cognitive constructivism learning theory. Bruner cited that learning is a process where learners are actively engaged which leads to construction of new knowledge and ideas. These new learning is based on the learners' current or previous knowledge. When learners are actively involved in learning, they are able to develop hypothesis, acquire decision-making skills as well as apply the knowledge acquired in practical experiences. This is because learners develop schemas which allows organization of experiences and information provided by the environment. Bruner (1966) added that knowledge should be structured and simplified. Concepts should be introduced to learners from simple to complex as well as from concrete to abstract. MacLeod (2015) asserts that the content of any curriculum should be organized in a spiral manner to allow learners build knowledge from what they already know in a continuous manner.

Constructivist theory by Bruner is a general framework for instructional processes founded upon various studies of cognition. The role of cognitive structure is for the purpose of organization of content in the mind of the learner, ensuring that the learner

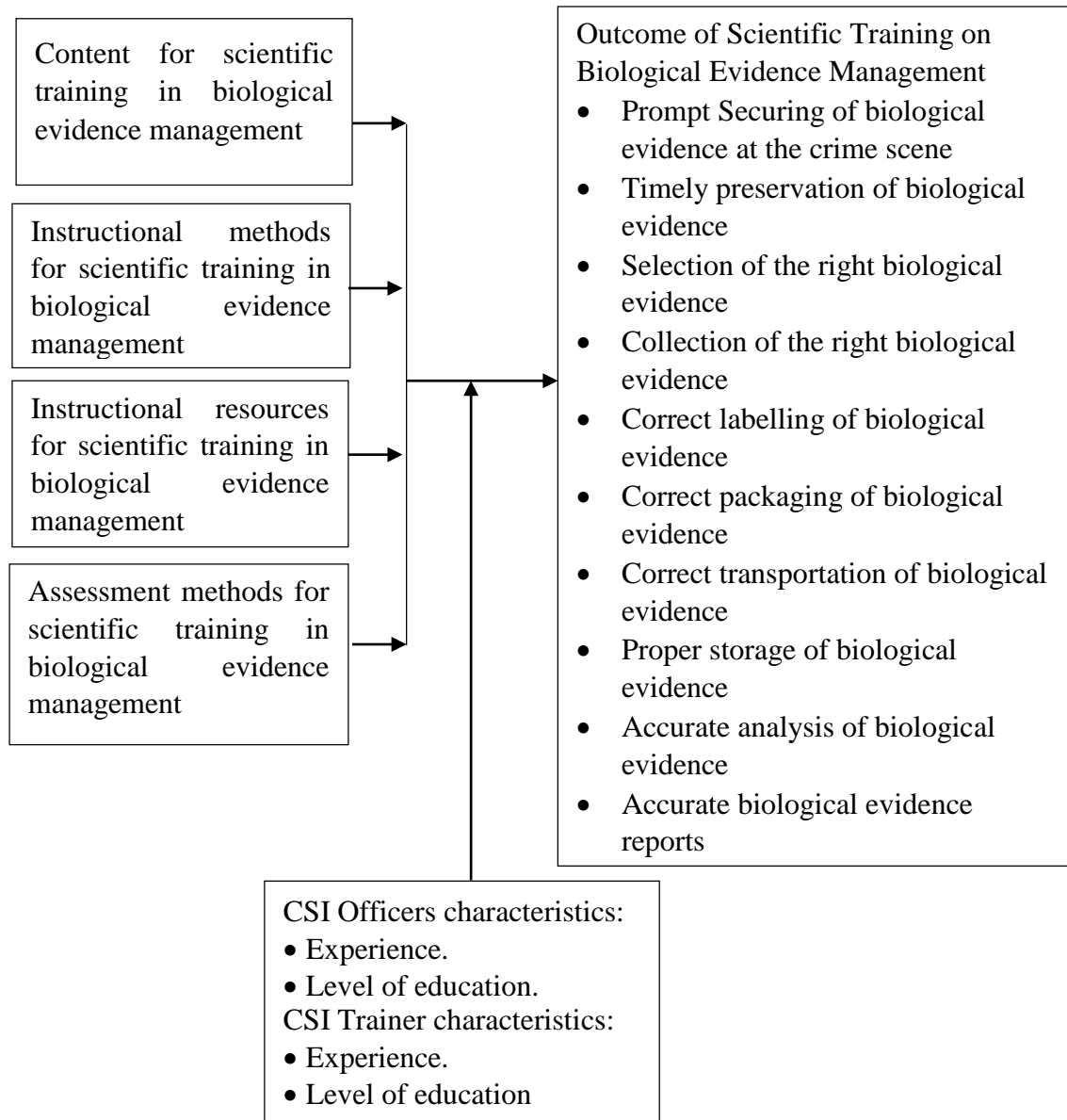
is ready to learn and development of analytical thinking. Instruction must be concerned with the experiences such as problem solving and contexts that allow learners to create their own perceptions and knowledge in regard to such experiences. For example, in a problem-solving experience the instructors act as facilitators while the learners find out ways of solving the existing problem. In a constructivist learning environment, the learner can collaboratively solve a problem through discussions, debates, brainstorming, experiments or multiple presentations. Instructors therefore should provide opportunities and tasks to learners to allow self-discovery of knowledge. Both the instructor and the learners should be actively engaged in dialogue where the instructor facilitate learning while the learners discover principles through experiences.

This theory is applicable to this study since during training of the crime scene investigators in crime scene investigation, the crime scene trainers have the responsibility of facilitating the learning process for all the trainees to actively and willingly participate while cooperating with the instructor and their colleagues. The trainer should ensure proper organization of subject matter of biological evidence training, readiness to learn by the trainees and development of analytical thinking. The instructor should also ensure that the trainees are able to develop cognition strategies such as self-reflection, clear understanding of situations and ability to probe for more information using inquisitive questions. During the constructivist learning environment, the trainers should ensure collaborative problem solving through discussions, debates, brainstorming, experiments and use of presentation.

The theory was relevant since it shows how the Crime Scene Trainers interact with the Biological Evidence Management Trainees in the process of teaching and learning. The Biological Evidence Management Trainees enter into a class of crime scene management with prior knowledge on which the Crime Scene Trainers build on in order for the BEM Trainees to acquire more knowledge and skills by creation of a conducive environment, avoiding rote-learning and mis-conceptions by learners. Therefore, the theory informed the current study in that scientific training on biological evidence management is a learning process where learners are actively engaged leading to construction of new knowledge and ideas for purpose of acquisition of knowledge and skills thus better management of crime scenes in Nairobi County, Kenya.

2.5 Conceptual Framework

The conceptualization of the relationship between pedagogical practices and outcome of scientific training in biological evidence management is the interaction of the study variable as illustrated



Independent variable Intervening Variables Dependent variable

Figure 1: The Conceptual Framework showing Relationship between Pedagogical Practices and Scientific Training in Biological Evidence.

According to the information in Figure 1, the Outcome of Scientific Training in Biological Evidence Management depends on pedagogical practices. Scientific training in biological evidence management encompasses of appropriate content, instruction methods, instructional resources and assessment methods. The indicators of outcome

of scientific training include: securing of biological evidence at crime scene, timely preservation of scientific evidence, selection of quality scientific evidence, collection of quality scientific evidence, correct labelling and packaging, correct transportation and correct storage of the scientific evidence, analysis and preparation of scientific evidence reports. Experience and level of education of both the Biological Evidence Management Trainees and their trainers determine the level of understanding for acquisition and transfer of knowledge and skills respectively.

CHAPTER THREE

METHODOLOGY

3.1 Research Design

The research design is a plan that most likely assists the researcher in the preparation and execution of the study in order to accomplish the targeted aim a (Orodho, 2015). This study was based on a descriptive survey design since it was capable of explaining the components of the research participants and the variables under study (Kombo & Tromp, 2016). Descriptive studies entail observation of a phenomenon at given point in time to find facts, formulate principles from the results as well as offer solutions to prevailing problems. This design was appropriate for the research since it had the ability to achieve direct source of all attributes required. Descriptive research design creates a good environment for interaction for thorough responses and sharing past experiences, ongoing and future happening in scientific training on biological evidence management thus elaborating the variables under study was to describe the state of scientific training on biological evidence management at Directorate of Criminal Investigation. An opportunity was given to the respondents who gave their views on the relationship of pedagogical practices and outcome of scientific training on biological evidence management in Nairobi County, Kenya.

3.2 Location of the Study

The research was carried out in Nairobi County where the largest country's capital is situated. Nairobi County bounders Kiambu to the North, North West and North East, Machakos county to the East and South East and Kajiado County to the South, South West and West. There are 17 sub-counties in Nairobi County namely; Dagoretti North, Dagoretti South, Embakasi Central, Embakasi East, Embakasi North, Embakasi South, Embakasi West, Kamukunji, Kasarani, Kibra, Langata, Makadara, Mathare, Roysambu, Ruaraka, Starehe and Wetlands. Nairobi is located with the GPS co-ordinates of 1° 17' 11.004" S and 36° 49' 2.0028" E.

3.3 Target Population

The study focused on Crime Scene management trainees who were undergoing a promotion course for members of inspectorate at National Police college (B Campus, Crime scene trainers based in Nairobi County and Quality Control Officers responsible

crime scene quality control making a total of 132 respondents. According to Kothari (2012) the target population comprised all participants in the study, who posed similar set of traits with respect to intended research. In addition, a target population is as a group of individuals that the researcher conducts research on (Barnsbee, 2018). For this study, the researcher included biological evidence management trainees, crime scene trainers and Quality Control Officers. The population was directly involved in scientific training on biological evidence management thus fit to provide the needed information.

3.4 Sampling Procedure and Sample Size

3.4.1 Sampling Procedure

Technique used by the researcher to choose representation of the targeted population is referred as sampling procedure (Mugenda & Mugenda, 2003). The study applied purposive sampling on Quality Control Officer (QCO) and stratified sampling on both the crime scene management trainees and Crime Scene trainers. The researcher had two strata which included Crime Scene Trainees and their trainers respectively. Respondents from each stratum were selected by use of simple random sampling procedure which gave an equal opportunity to the respondents for being chosen to take part in the research.

3.4.2 Sample Size

The study adopted sample size determining formula by Krejcie and Morgan (1970). According to Krejcie and Morgan table (Appendix V), the sample size for a population of 198 was 132. The sample was distributed as shown on the sampling matrix on table 1.

Table 1: Sampling Matrix

Respondents	Population	Sample Size
Crime Scene Management Trainees	130	87
Crime Scene Trainers	50	33
Quality Assurance Officers	18	12
Total	198	132

The calculation of the proportionate sample size of biological evidence trainees, the crime scene trainers and Quality Control Officers was as follows; Where n represents the sample size.

Biological Evidence Trainees (sample size) $n = \frac{\text{Total sample size}}{\text{Total Population}} \times 130$

$$n = \frac{\text{Total sample size}}{\text{Total Population}} \times 130$$

$$n = \frac{132}{198} \times 130$$

$$n = 87$$

Crime Scene Trainers (sample size) $n = \frac{\text{Total sample size}}{\text{Total Population}} \times 50$

$$n = \frac{132}{198} \times 50$$

$$n = 33$$

Quality Control Officers $n = \frac{\text{Total sample size}}{\text{Total Population}} \times 18$

$$n = \frac{132}{198} \times 18$$

$$n = 12$$

The total sample size was 132.

3.5 Research Instruments

The research employed interviews and structured questionnaire for data collection. An Interview schedule containing four questions was used where question one was seeking information on the duration served in the office, the second question information on quality of training in terms of content, instruction methods, instruction resources and assessment methods. Question three sought information on weaknesses on scientific training on biological evidence management and question four any other information that the respondent wished to give the researcher (Appendix II).

A questionnaire was most preferred for quantitative studies it could collect data from a large population of respondents at the same time (Kothari, 2009). The questionnaire used was similar for both the Biological Evidence Management trainees and their trainers for purpose of gathering information that was to assist the researcher to achieve the research objectives. The respondent was to choose the extent to which the items in the questionnaire related to training in crime scene investigation. The questionnaire was made up of six parts; part A to F (Appendix III & IV).

Part A was to collect information on respondents' demographic information, Part B sought to establish information on content of training. The part contained ten statements

each in the Likert scale at 5 levels. Part C was to collect data on instructional methods and mode of study used during scientific training on biological evidence management. This part was divided into two sections that is, section 1 and 2. Section 1 was to collect data on instructional methods and section 2 on mode of transmission which could be face-to-face, on-line or both. Section 1 and 2 contained eight and three items respectively, all in Likert scale at 5 levels. Part D sought to establish information on scientific training instructional resources. It contained ten statements each in Likert scale at 5 levels. Part E was to establish information about scientific training assessment methods. It contained ten items, each in Likert scale at 5 levels. This part sought to establish outcome of scientific training on biological evidence in-terms of competency. The part contained ten statements, each in Likert scale at 5 levels.

3.6 Piloting

A pilot study was undertaken at National Police Service College (B Campus) and DCI headquarters to pretest the research instruments. The study used a pilot sample which was 10% of the probable larger study sample (Connelly. 2008). The pilot study was conducted on two (2) Quality Control Officers, nine (9) Crime Scene Management trainees and three (3) Crime Scene Trainers. The pilot test is a pre-trial of the larger research exercise which allows the researcher to have a picture of what they expect as they proceed to the field (Kannan, 2015). Pretesting helped in determining the appropriateness and simplicity of administering the instruments such as questionnaires. For the purposes of improving internal applicability of questionnaires, the questionnaires were administered in the same way as in the study. The respondents were allowed to give their views in respect to the items on the questionnaire for purpose of improvement.

3.6.1 Reliability

The split-half test method was adopted. The internal consistency of items was measured by use of Cronbach's alpha. Reliability being a measure of scale reliability, it was used by the researcher to measure the reliability of all items contained in the questionnaires of both the Crime Scene Management Trainees and their trainers. Fraenkel and Wallen (2012) cited that for descriptive surveys, the acceptable coefficient of reliability is 0.7 and above. The reliability coefficient for this study ranged from 0.825 for instructional

methods to 0.965 for outcome of scientific training on BEM, while that of variables in trainers' questionnaires ranged between 0.876 and 0.950.

3.6.2 Validity

To achieve face validity, the researcher ensured that each study variable was adequately catered for by items in the research instruments in an organized. The content validity of the items was established by seeking the views of experts in the education field. For the purpose of the study, the researcher requested various lecturers from Chuka University to scrutinize and judge whether the content in the items was relevant to the research.

3.7 Data Collection Procedures

The researcher developed research instruments for purpose of data collection. In order to administer the research instruments which were in form of questionnaires and interview schedules, the researcher made a formal request to the Police training institution. On approval of appointment, the researcher interacted with both the Crime Scene Management trainees, Trainers and QCO at their work stations and training institutions through interviews and questionnaires respectively. The respondents were informed about the aim and purpose of the study through an introductory letter. The researcher had to wait for the respondent to fill the questionnaire in order to collect them on the same day to prevent misplacement or loss while in the hands of the respondents. The interview was self-administered to Quality Control Officers on specific days, filled during the interaction sessions with the respondents and collected for purpose of data analysis.

3.8 Data Analysis

Data obtained was reviewed, sorted, coded and computed using the Statistical Package for social science software version 25.0. Chi-square, test of hypothesis, descriptive and inferential type of statistics was employed in the study. Data was interpreted by use of means and percentages and presented by use of tables.

3.9 Data Analysis Matrix

Table 2: Data Analysis Matrix

Hypothesis	Independent variable	Dependent variable	Test Statistic
H ₀₁ There is no statistically significant relationship between content and outcome of scientific training on biological evidence in Nairobi County, Kenya	Content of biological evidence management	Outcome of Scientific training	Chi-square
H ₀₂ There is no statistically significant relationship between instructional methods and outcome of scientific training on biological evidence in Nairobi County, Kenya	Instruction methods in biological evidence management	Outcome of scientific training	Chi-square
H ₀₃ There is no statistically significant relationship between instructional resources and outcome of scientific training on biological evidence in Nairobi County, Kenya	instruction resources for biological evidence management	Outcome of scientific training	Chi-square
H ₀₄ There is no statistically significant relationship between assessment methods and outcome of scientific training on biological evidence in Nairobi County, Kenya	Assessment methods for biological evidence management	Outcome of scientific training	Chi-square

3.10 Ethical Considerations

Ethical consideration in research is a set of principles that guide one's research designs and practices. According to Silverman (2011), research ethics include confidentiality, anonymity, potential for harm and communication of results, informed consent and voluntary participation. Therefore, all the participants were informed about the purpose of the study through an introductory letter which required the respondent to append their signature as an indication that they were taking part in the exercise willingly. Respondents' confidentiality was ensured by omitting their names, contacts and any other personal details that could reveal their identity. To ensure compliance with ethical considerations, the was submitted to the Ethical Committee of Chuka University for Ethical review. After ethical review, a letter of authorization to conduct research was issued by the University which enabled the researcher to obtain a permit from National Commission for Science, Technology & Innovation (NACOSTI) for purpose of data collection.

CHAPTER FOUR

DATA ANALYSIS

4.1 General Information

In this chapter, the researcher has presented the summaries of the data obtained and its interpretations as well as discussions according to study objectives. The study sought to establish the relationship between content of biological evidence management and outcome of scientific training, determine the relationship between instructional methods for biological evidence management and outcome of scientific training, establish the relationship between instructional resources for biological evidence management and outcome of scientific training and determine the relationship between assessment methods in biological evidence management and outcome of scientific training in Nairobi County, Kenya.

To achieve the research purpose, the researcher employed descriptive survey research design. A sum of 127 respondents who were sampled participated in the study. The respondents comprised of 87 BEM trainees, 32 BEM trainers and 8 Quality Control Officers. Compared to the anticipated 132 respondents initially sampled, the study attained a 96.21% response rate which according Babbie and Muoton (2002) is an acceptable response rate.

4.1.1 Reliability Index

Prior to analysis, reliability of the study variables was tested using Cronbach's Alpha and the findings were as indicated in Table 3.

Table 3: Reliability Index

Variable	BEM trainees Questionnaire		Trainers' Questionnaire	
	Items	Cronbach's Alpha	Items	Cronbach's Alpha
Content	10	0.962	10	0.913
Instructional Method	8	0.825	8	0.876
Instructional Resources	10	0.956	10	0.913
Assessment Method	10	0.960	10	0.926
Outcome of Scientific training on BEM	10	0.965	10	0.950

Information obtained show that reliability index on content for trainees' questionnaire was 0.962, 0.825 on instructional methods, 0.956 on instructional resources and 0.965

on assessment methods. The reliability index on content trainer's questionnaire was 0.913, 0.876 on instructional methods, 0.913 on instructional resources and 0.926 on assessment methods. The reliability index on outcome of scientific training on BEM was 0.965 for BEM trainee's questionnaire and 0.950 for Trainer's questionnaire respectively. above as required by Fraenkel and Wallen (2012) and therefore were all adopted for further analysis.

4.2 Demographic Information

Demographic information was sought from sampled respondents who included trainees, their trainers and Quality Control Officers. This section presents findings of each sequentially.

4.2.1 Biological Evidence Management Trainees' Demographic Information

Information was sought on trainees' demographic variables including gender, age and level of education among others. Table 4 gives a summary of these attributes. Data obtained show that there were more male BEM trainees (80.6%) compared to females (19.4%). This implies a skewed distribution of the trainees based on gender with males being almost four times as many as the females. Information on age show that a majority (97.1%) BEM trainees were in the 30-50 years age bracket compared to those above 50 years old (1.9%) or less than 30 years (1.0%). This means that almost all the BEM trainees were in their most productive stages of their career.

Information on the BEM trainees' level of education show that slightly less than three quarters (73.8%) were graduates with bachelor degree while the remainder (26.2%) had postgraduate qualifications. Findings imply that the BEM trainees are highly educated but not in the area of biological sciences which is more suited for scientific training in biological Evidence management. They indicated that their specific areas of specialization included Criminology (36.8%), Peace and Security studies (21.8%), Business Administration (10.2%) and Forensic Science (9.2%). Other areas of specialization include Political Science (3.4%), Public Administration (3.4%), ICT (2.3%) Project Planning (8.0%) and Education (4.6%). A majority of the BEM trainees (89.3%) acknowledged having interacted with biological evidence as a police officer.

Slightly less than a half (43.7%) of these trainees indicated having not received scientific training on biological evidence management.

Table 4: Demographic Information of BEM Trainees

Variable	Category	Frequency	Percentage
Gender	Male	68	78.2
	Female	19	21.8
	Total	87	100.0
Age	Below 30	1	1.1
	30-50	84	96.6
	Above 50	2	2.3
	Total	87	100.0
Education	Graduate	60	69.0
	Postgraduate	27	31.0
	Total	87	100.0
Interacted with biological evidence (BE)	Yes	77	88.5
	No	10	11.5
	Total	87	100.0
Trained on BE management	Yes	38	43.7
	No	49	56.3
	Total	87	100.0
Taught on BE management during CSM	Yes	74	85.1
	No	13	14.9
	Total	87	100
Number of lessons	Less than 3	77	88.5
	3-6	6	6.8
	More than 6	4	4.7
	Total	87	100.0
Training duration	1 day	84	96.6
	2-7 days	2	2.3
	> 1 week	1	1.1
	Total	87	100.0
Frequency of retraining	Quite often	2	2.3
	1-3 years	4	4.6
	4-6 years	2	2.3
	Not often	79	90.8
	Total	87	100.0

N=87

Further, a significant proportion of the BEM trainees (85.1%) acknowledged receiving biological evidence management scientific training. Such training took less than 3 lessons according to a significant proportion of the officers (88.5%) per day (96.6%) but was not as frequent as could be desired according to a majority (90.8%) of the respondents.

4.2.2 Biological Evidence Management Trainers' Demographic Information

Information was sought on trainers' demographic variables including gender, age and level of education among others. Table 5 presents the summary of the findings.

Table 5: Demographic Information of BEM Trainers

Variable	Category	Frequency	Percentage
Gender	Male	23	71.9
	Female	9	28.1
	Total	32	100.0
Age in years	Below 30	1	3.1
	30-50	31	96.9
	Total	32	100.0
Education	Diploma	7	21.9
	Graduate	18	56.2
	Postgraduate	7	21.9
	Total	32	100.0
Experience in years	Less than 5	10	31.2
	5-10	18	56.2
	More than 10	4	12.6
	Total	32	100.0
Type of training	Pre-service	3	9.3
	In-service	15	46.9
	On the job training	14	43.8
	Total	32	100.0
Training period	Less than 1 month	4	12.6
	1 – 4 months	16	50.0
	5-12 months	5	15.6
	More than 1 year	7	21.8
	Total	32	100.0
Category of training	Local	20	62.4
	International	6	18.8
	Both	6	18.8
	Total	32	100.0
Frequency of training	Quite often	3	9.4
	1-3 years	5	15.6
	More than 3 years	4	12.6
	Not often	20	62.4
	Total	32	100.0

N=32

Data obtained show that there were more male BEM trainers (71.9%) compared to females (28.1%). This implies a skewed distribution of the trainers based on gender with males being more than twice as many as the females. Information on age show that a majority (96.9%) the trainers were in the 30-50 years age bracket compared to

those above or less than 30 years (3.1%) old. This means that almost all the CSI trainers were in their most productive stages of their career.

Information on the BEM trainers' level of education show that slightly less a quarter (21.9%) were diploma graduates, more than a half (56.2) had bachelor degree qualification while the remainder (21.9%) had postgraduate qualifications. Findings imply that the trainers are equally highly educated with relevant academic qualification suited for their jobs. Their level of experience ranged from less than 5 years (31.2%) through 5 – 10 years (56.2%) to more than 10 years (12.6%) implying that a considerable population of the trainers (68.8%) had the appropriate experience.

As regards training in crime scene management, more trainers (46.9%) indicated having undergone in-service training (43.8%) compared to those who underwent on-the job or pre-service training (9.3%). For a half of the trainers (50.0%), the training took between 1 and 4 months compared to less than 1 month (12.5%), 5 to 12 months (15.7%) or more than a year (21.8%). This means that for a majority of the trainers, the training period was not adequate enough for mastery of technical concepts. The training were held locally for a majority of the trainers (62.4%) compared to those held internationally (18.8%) or both locally and internationally (18.8%). However, for a majority of the trainers (62.4%) there were no frequent refresher courses to enable them update their knowledge and skills.

4.2.3 Quality Control Officers' Demographic Information

Key informant interview was undertaken to provide qualitative data needed to plug gap in information obtained through the BEM trainees and BEM trainers questionnaires. Eight Quality Control Officers (QCO) sampled participated in the interview. QCO term of service ranged between 1 to 7 years. Letters A to H were used in the document to present qualitative data obtained from each of them without breaking anonymity and confidentiality rule of Research ethics.

4.3 Results and Discussions

The research sought in establishing the link between pedagogical practices and the outcome of scientific training in biological evidence management in Nairobi County, Kenya. Respondents were provided with a set of ten statements to indicate their perception of the extent to which scientific training in biological evidence management enable CSI to be competent. Table 6 presents a summary of data obtained from BEM trainees. Information obtained from BEM trainees show that a majority of them felt that the scientific training in biological management to a great or very great extent catered for securing of crime scene (74.8%), preservation of biological evidence (69.0%) and selection of biological evidence (66.7%). Similarly, a significant proportion of the trainees confirmed that the scientific training adequately equipped them with skills in collection of biological evidence (60.9%), labelling of biological evidence (63.2%), packaging of biological evidence (66.7%) and transportation of biological evidence (58.6%) to a great extent or very great extent.

Table 6: Efficacy of Scientific Training in Biological Evidence Management (Trainees)

Competence in	NE	LE	ME	GE	VGE	Total
Securing of crime scene	5.7	8.0	11.5	31.0	43.8	100.0
Preservation of biological evidence	3.5	8.0	19.5	34.5	34.5	100.0
Selection of biological evidence	4.6	9.2	19.5	36.8	29.9	100.0
Collection of biological evidence	6.9	12.6	19.5	33.3	27.6	100.0
Labelling of biological evidence	4.6	9.2	23.0	31.0	32.2	100.0
Packaging of biological evidence	4.6	13.8	14.9	39.1	27.6	100.0
Transportation of biological evidence	4.6	21.9	14.9	31.0	27.6	100.0
Storage of biological evidence	11.5	23.0	12.6	28.7	24.2	100.0
Analysis of biological evidence	27.6	6.9	16.1	25.3	24.1	100.0
Writing of biological evidence reports	29.9	6.9	11.5	24.1	27.6	100.0

Key: No extent (NE), Little Extent (LE), Moderate Extent (ME), Great Extent (GE), Very Great Extent (VGE)

At the same time, slightly more than a half of the trainees indicated that the scientific training in biological evidence management equipped them with necessary skills in storage of biological evidence (52.9%) and writing of biological evidence reports (51.7%) to a great or very great extent while slightly less than this proportion (49.4%) felt that it had equipped them with necessary skills for analysis of biological evidence to a great or very great extent. Findings imply that a majority of the BEM trainees

(61.39%) believed that scientific training in biological evidence had adequately equipped them with biological evidence skills for crime scene management. Table 7 contains a summary of data obtained from the BEM trainers.

Information obtained from BEM trainers show that a majority of them believed that the scientific training in biological evidence management to a great or very great extent adequately provided for securing of crime scene (87.4%), preservation of biological evidence (87.4%) and selection of biological evidence (84.3%). Similarly, a significant proportion of the trainers confirmed that the scientific training could adequately equip trainees with skills in collection of biological evidence (87.4%), labelling of biological evidence (90.6%), packaging of biological evidence (87.5%) and transportation of biological evidence (59.3%) to a great extent or very great extent.

Table 7: Efficacy of Scientific Training in Biological Evidence Management (Trainers)

Competence in	NE	LE	ME	GE	VGE	Total
Securing of crime scene	6.3	-	6.3	9.4	78.0	100.0
Preservation of biological evidence	6.1	-	6.5	37.4	50.0	100.0
Selection of biological evidence	5.9	-	9.8	50.0	34.3	100.0
Collection of biological evidence	6.0	-	6.6	46.9	40.5	100.0
Labelling of biological evidence	4.9	-	5.5	46.9	43.7	100.0
Packaging of biological evidence	6.3	-	6.3	37.5	50.0	100.0
Transportation of biological evidence	6.3	6.3	28.1	31.2	28.1	100.0
Storage of biological evidence	6.3	3.1	34.4	12.5	43.8	100.0
Analysis of biological evidence	28.1	3.1	12.5	25.0	31.3	100.0
Writing of biological evidence reports	25.0	6.3	9.4	21.9	37.4	100.0

Key: No extent (NE), Little Extent (LE), Moderate Extent (ME), Great Extent (GE), Very Great Extent (VGE)

At the same time, slightly more than a half of the trainers indicated that the scientific training in biological evidence management was adequate in inculcating in trainees' skills in storage of biological evidence (56.3%), analysis of biological evidence (56.3%) and writing of biological evidence reports (59.3%) to a great or very great extent. Findings imply that about three quarters of the BEM trainers (75.58%) believed that scientific training in biological evidence could adequately equip trainees with biological evidence skills for crime scene management.

4.3.1 Relationship between Content and the Outcome of Scientific Training in Biological Evidence Management

The first objective sought to establish the relationship between subject content and scientific training in biological evidence management. BEM trainees and their trainers were provided with statements on training content. Table 8 presents a summary of data obtained from the BEM trainees.

Table 8: Subject Content and Scientific Training on BEM (Trainees)

Content for training adequately covers	NE	LE	ME	GE	VGE	Total
Securing of crime scene	6.9	13.8	21.8	39.1	18.4	100.0
Preservation of biological evidence	10.3	16.1	24.1	31.0	18.4	100.0
Selection of biological evidence	10.3	11.5	28.7	32.2	17.2	100.0
Collection of biological evidence	9.2	11.5	34.5	28.7	16.1	100.0
Labelling of biological evidence	9.2	12.6	25.3	26.4	26.4	100.0
Packaging of biological evidence	9.2	19.5	24.1	32.2	14.9	100.0
Transportation of biological evidence	11.5	27.6	27.6	23.0	10.3	100.0
Storage of biological evidence	17.2	26.4	24.1	14.9	17.2	100.0
Analysis of biological evidence	39.1	17.2	18.4	9.2	16.1	100.0
Biological Evidence report writing	39.1	17.2	18.4	9.2	16.1	100.0

Key: No extent (NE), Little Extent (LE), Moderate Extent (ME), Great Extent (GE), Very Great Extent (VGE)

Information obtained from the BEM trainees show that more than half of them (57.5%) believe that content of scientific training in biological evidence management adequately covers securing of crime scene, slightly less than a half (49.4%) felt it adequately covers preservation of biological evidence and selection of biological evidence (49.4%) while slightly less than this proportion (44.8%) believed the content adequately covers collection of biological evidence to a great extent or very great extent. Additionally, more than a half of the officers (52.8%) indicated that the content adequately covers labelling biological evidence, less than a half (47.1%) believed that it adequately covers packaging of biological evidence and about a third of the trainees (33.3%) adequately covers transportation of biological evidence to a great or very great extent. Lastly, about a third of the BEM trainees (32.1%) indicated that the content adequately covers storage of biological evidence, about a quarter of the BEM trainees believe it adequately covers analysis of biological evidence (25.3%) and biological evidence report writing (25.3%) to a great and very great extent. Findings mean that on average, less than half of the BEM trainees (41.7%) sampled believe that content for scientific training adequately

covers biological evidence management concepts to a great or very great extent. Table 9 presents findings from BEM trainers on content for biological evidence management training concepts.

Table 9: Content for Scientific Training on BEM (Trainers)

Content for training adequately covers	NE	LE	ME	GE	VGE	Total
Securing of crime scene	-	6.3	6.3	21.8	65.6	100.0
Preservation of biological evidence	-	9.4	12.5	31.3	46.8	100.0
Selection of biological evidence	-	15.6	6.3	43.8	34.4	100.0
Collection of biological evidence	-	12.5	6.3	43.8	37.4	100.0
Labelling of biological evidence	-	6.3	6.3	31.3	56.3	100.0
Packaging of biological evidence	-	9.4	6.3	43.8	40.5	100.0
Transportation of biological evidence	3.1	12.5	15.6	43.8	25.0	100.0
Storage of biological evidence	-	15.6	40.6	15.6	28.1	100.0
Analysis of biological evidence	25.0	21.9	21.9	9.4	21.9	100.0
Biological Evidence report writing	25.0	21.9	9.4	15.6	28.1	100.0

Key: No extent (NE), Little Extent (LE), Moderate Extent (ME), Great Extent (GE), Very Great Extent (VGE)

Information obtained from the BEM trainers show that a significant majority of the trainers (88.4%) believe that content of scientific training in biological evidence management adequately covers securing of crime scene, more than three quarters (78.1%) felt it adequately covers preservation of biological evidence and selection of biological evidence (78.2%) while a significant majority of the trainers (82.2%) believe the content adequately covers collection of biological evidence to a great extent or very great extent. Additionally, a significant majority of the trainers (87.6%) indicated that the content adequately covers labelling biological evidence, slightly less than this proportion (84.3%) believed that it adequately covers packaging of biological evidence and about two third of the trainers (68.8%) adequately covers transportation of biological evidence to a great or very great extent. Lastly, less than a half of the CSI trainers (43.7%) indicated that the content adequately covers storage of biological evidence, less than a quarter OF BEM trainees (30.3%) believe it adequately covers analysis of biological evidence and more than this proportion (43.7%) indicated that the content was adequate for biological evidence report writing to a great and very great extent. Findings mean that on average, more than two thirds of the BEM trainers (68.53%) sampled believed that content for scientific training adequately covers biological evidence management concepts to a great or very great extent.

Results obtained from the BEM trainees were cross-tabulated against their conception of the appropriateness of Scientific Training on Biological Evidence Management. Findings were as presented in Table 10.

Table 10: Content for BEM Training against Outcome of Scientific Training in BEM

		Content of BET		Total	
		Not adequate	Adequate		
Outcome of Biological Evidence Training	Not Appropriate	f	28	4	32
	Appropriate	%	32.2	4.6	36.8
		f	18	37	55
		%	20.7	42.5	63.2
Total		f	46	41	87
		%	52.9	47.1	100.0

Findings from cross-tabulation show that slightly less than half of the CSM trainees (47.1%) believed that content for scientific training in biological evidence management was adequate compared to those who felt it was not adequate. Of those who believed that the content was adequate, a significant proportion (42.5%) felt that training in biological evidence was appropriate compared to those whose thoughts were to the contrary (4.6%). On the contrary, more of those who believed that the content was not adequate (32.2%) felt that training in biological evidence was not appropriate compared to those who indicated it was appropriate (20.7%). Chi square analysis was used to interpret this observation. Table 11 presents its findings.

Table 11: Relationship between Content and Outcome of Scientific Training in BEM

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	CC
Pearson Chi-Square	24.357 ^a	1	.000			.468
Continuity Correction ^b	22.208	1	.000			
Likelihood Ratio	26.661	1	.000			
Fisher's Exact Test				.000	.000	
Linear-by-Linear Association	24.077	1	.000			
N of Valid Cases	87					

The Chi square results $\chi^2 (1) = 24.357, p < 0.001$ showed that there exists a significant relationship between subject content and the outcome of scientific training in biological

evidence management. Contingency Coefficient measure of Association (CC) illustrated that 46.8% of the total variance in the outcome of scientific Training could be attributed to Content for Scientific Training on Biological Evidence Management. Findings therefore led to the rejection of the first hypothesis, H_{01} which stated that there is no statistically significant relationship between content for biological evidence management and outcome of scientific training in Nairobi County, Kenya. Qualitative data obtained from the QCO illustrated that the content for scientific training on biological evidence management covered the main areas critical for scientific training. According to interviewee B, content areas in scientific training on biological evidence management are;

Collection and preservation of biological evidence such as DNA, blood, body tissues, body fluids among others. Other areas dealt with processing of crime scenes involving biological evidence to facilitate collection without contamination.

However, almost all the interviewees were in agreement that the content was inadequate for effective biological evidence training. Interviewee A noted that the content was “never enough thus was covered within a short time. In supporting this observation, interviewee D stated that, “if it was adequate, it could not be possible to cover within one or two lessons”

An analysis information obtained from the study show that generally, the content was appropriate for biological evidence management in some critical areas of scientific training. Descriptive data illustrated that content adequately provided for concepts such as securing of crime scene, collecting, preserving, labelling, packaging and transportation of biological evidence. Qualitative data obtained illustrated that content for training in biological evidence management was inadequate thus enabling the work to be covered in a very short time. Maryln and Miller (2017) argued that for efficient crime scene management, there are some factors to be considered such as identified sufficient and appropriate training of CSIs, provision of relevant resources and a conducive working environment free from any source of interference with a strengthened and functioning legal framework to direct and dictate the process of crime scene management. For proper development of capacity in crime scene investigators, the study emphasized that providing an ideal working environment and good

remuneration is not a surety until it is matched with a properly trained, professional, and competent investigators.

Inferential analysis illustrated a significant relationship between content and scientific training in biological evidence management. Oketch et al. (2012) investigated the influence of actively engaging learners during class activities on their performance among primary school learners in Kenya. One of the study objectives was to assess the length of time the learners were exposed to a certain content and later compare the difference in performance. The results obtained from the study showed that the level of exposure to the curriculum content led to better performance among the learners.

4.3.2 Relationship between Instructional Method and the Outcome of Scientific Training in Biological Evidence Management

Secondly, the researcher sought to determine the relationship between instructional methods and scientific training in biological evidence management. BEM trainees and their trainers were provided with statements on training content. Table 12 presents a summary of data obtained from the BEM trainees.

Table 12: Extent of Use of Method of Learning in BEM (Trainees)

Method of learning	NE	LE	ME	GE	VGE	Total
Lecture	4.7	8.0	23.0	47.1	17.2	100.0
Group discussion	12.6	18.4	37.9	19.5	11.5	100.0
Practical work	17.2	26.4	27.6	18.4	10.3	100.0
Demonstration	13.8	28.7	26.4	19.5	11.5	100.0
Presentation	19.5	23.0	28.7	17.2	11.5	100.0

Key: No extent (NE), Little Extent (LE), Moderate Extent (ME), Great Extent (GE), Very Great Extent (VGE)

Information contained in Table 12 show that according to the BEM trainees, lecture method (64.3%) was the most preferred method for scientific training in BEM to a great and very great extent according to a majority of the trainees. Other methods which were adopted for scientific training in BEM include group discussion (31.0%), demonstration (31.0%), practical work (28.7%) and presentation (28.7%). Results show high preference of teacher centered methods over learner-centered methods for scientific training in BEM. Table 13 presents a summary of data obtained from BEM trainers.

Table 13: Extent of Use of Method of Learning in BEM (Trainers)

Method of learning	NE	LE	ME	GE	VGE	Total
Lecture	6.3	9.4	9.4	37.5	37.5	100.0
Group discussion	6.3	6.3	31.3	40.6	15.6	100.0
Practical work	6.3	3.1	21.9	34.4	34.4	100.0
Demonstration	18.8	-	21.9	34.4	25.0	100.0
Presentation	18.8	12.5	18.8	21.9	28.1	100.0

Key: No extent (NE), Little Extent (LE), Moderate Extent (ME), Great Extent (GE), Very Great Extent (VGE)

Information obtained from the BEM trainers confirmed use of lecture method (75.0%) as the most preferred method for scientific training in BEM to a great and very great extent. Other methods which were adopted for scientific training in BEM to a great and very great extent include practical work (68.8%), demonstration (59.4%), group discussion (56.2%) and presentation (50.0%). Results therefore confirm preference of use of teacher centered methods such as lecture method for scientific training in BEM. Table 14 and 15 contain information on the modes for scientific training in BEM.

Table 14: Extent of Use of Mode of Learning in BEM (Trainees)

Mode of learning	NE	LE	ME	GE	VGE	Total
Face-to-face	8.0	5.7	11.5	43.7	31.0	100.0
On-line	47.1	29.9	9.2	12.6	1.1	100.0
Blended learning	34.5	24.1	20.7	10.3	9.3	100.0

Key: No extent (NE), Little Extent (LE), Moderate Extent (ME), Great Extent (GE), Very Great Extent (VGE)

Results contained in Table 14 show that according to the BEM trainees, face-to-face (74.7%) was the most common mode of learning for scientific training in BEM followed by blended learning (19.6%) and lastly on line (13.7%). Table 15 contains data obtained from the BEM trainers.

Table 15: Extent of Use of Mode of Learning in BEM (Trainers)

Mode of learning	NE	LE	ME	GE	VGE	Total
Face-to-face	6.3	6.3	9.4	6.3	71.9	100.0
On-line	34.4	28.1	18.8	18.8	-	100.0
Blended learning	21.9	12.5	31.3	31.3	3.1	100.0

Key: No extent (NE), Little Extent (LE), Moderate Extent (ME), Great Extent (GE), Very Great Extent (VGE)

Results obtained from the BEM trainers show a similar trend, face-to-face (77.2%) being the most common mode of learning for scientific training in BEM followed by blended learning (34.4%) and lastly on line (18.8%). The study thus proceeded to assess the existing relationship between instructional method for scientific training and the outcome on scientific training on BEM. Table 16 presents results of the Chi square analysis undertaken.

Table 16: Relationship between Instructional Method and Outcome of Scientific Training in BEM

	Value	df	Asymptotic Significance (2- sided)	Exact Sig. (2- sided)	Exact Sig. (1- sided)	CC
Pearson Chi-Square	25.724 ^a	1	.000			.478
Continuity Correction ^b	23.506	1	.000			
Likelihood Ratio	28.858	1	.000			
Fisher's Exact Test				.000	.000	
Linear-by-Linear Association	25.428	1	.000			
N of Valid Cases	87					

The Chi square results $\chi^2 (1) = 25.724$, $p < 0.001$ showed that there exists a significant relationship between instructional method and the outcome of scientific training in BEM. Contingency Coefficient measure of Association (CC) illustrated that 47.8% of the total variance in the outcome of scientific training in BEM could be attributed to instructional method for Scientific Training on BEM. Findings therefore led to the rejection of the second hypothesis, H_{02} which stated that there is no statistically significant relationship between instructional methods and outcome of scientific training on biological evidence management in Nairobi County, Kenya. Generally, descriptive data illustrated preference for use of teacher-centered teaching methods such as lecture for scientific training in BEM. This was confirmed by interviewees who unanimously agreed that lecture method was the most predominant method used for instruction during scientific training for biological evidence management. According to Kaur (2020), lecture method enables the crime scene trainers to share knowledge and skills with their trainees when they have limited time especially when the time allocated for a course is not sufficient. However, Sharma (2020) noted that the method provides

minimal opportunity for learner activity which is a fundamental basis for effective learning. Additionally, lecture method rarely considers individual differences of the learners and often results to a teacher becoming monotonous to the students.

Inferential analysis illustrated a significant relationship between instructional method and scientific training in biological evidence management. Wabwoba (2019) in a study aimed at investigating the impact of instructional methods on learners' performance in English language at KCPE in Korogocho, Nairobi city, Kenya established a positive relationship between teaching method and instruction in English language. Cross-sectional survey design was adapted. The respondents were non formal primary schools, directors, teachers and pupils. Data collection was by means of questionnaires, focus group discussions and lesson observations. The study recommended adoption of more modern methods for instruction of the subject.

Munyaradzi (2013), carried out a study in South Africa on the relationship between teaching strategies and student's achievement. The researcher adopted experimental design and compared three methods of teaching. The results demonstrated that the interactive method between the teacher and the student had the greatest impact on the student's achievement while heuristic methods were the least effective in terms of student's performance. In Kenya, Jepketer (2017) carried out a study to assess the impact of teaching methods on student's performance in Nandi County. The researcher based the study on instruction guided theory. The study found that Gagnes' theory was relevant to the study. The study also found out that government policies acted as mediators on the link between instructional methods and the student's achievement.

4.3.3 Relationship between Instructional Resources and Outcome Scientific Training on Biological Evidence Management

The third objective sought to determine the relationship between instructional resources and outcome of scientific training in biological evidence management. BEM trainees and their trainers were provided with statements on training content. Table 17 summarizes the data collected from the BEM trainees.

Table 17: Extent of Use of Instructional Resources for Learning in BEM (Trainees)

Learning Resource	NE	LE	ME	GE	VGE	Total
Forensic Biology Laboratory	36.8	11.5	19.5	14.9	17.2	100.0
Forensic Chemistry Laboratory	35.6	16.1	19.5	10.3	18.4	100.0
CSI Simulation room	25.3	19.5	29.9	18.4	6.9	100.0
CSI Demonstration room	20.7	24.1	27.6	21.8	5.7	100.0
Audio materials such as teleconferencing equipment, speakers	29.9	21.8	27.6	16.1	4.6	100.0
Audio-visual materials such as, Television, lap top, desk tops	31.0	18.4	27.6	14.9	8.0	100.0
Printed materials such as, crime scene investigation text books	29.9	17.2	18.4	20.7	13.8	100.0
Real objects/items such as, hair, bones	35.6	19.5	20.7	16.1	8.0	100.0
Specimens such as, plant cells, blood samples	34.5	23.0	13.8	16.1	12.6	100.0
Models such as, casted footprint by use of plaster of Paris.	35.6	27.6	16.1	11.5	9.2	100.0

Key: No extent (NE), Little Extent (LE), Moderate Extent (ME), Great Extent (GE), Very Great Extent (VGE)

Information obtained from the BEM trainees indicated that printed materials (34.5%) was the most preferred instructional material for training in BEM followed by forensic biology laboratory (32.1%) and forensic chemistry laboratory (28.7%). Other fairly utilized instructional materials included CSI demonstration room (27.5%), specimens such as blood samples (26.7%), CSI simulation room (25.3%) and audio-visual materials (22.9%). Instructional materials such as real objects (22.1%), audio materials (20.7%) and models (20.7%) though critical in the instructional process to aid learners' practical experience were minimally used to a great and very great extent. Table 18 presents findings from BEM trainers.

According to the BEM trainers, printed materials (65.6%) was the most integrated instructional resource in scientific training in BEM followed by CSI demonstration rooms (62.5%) and audio-visual materials (53.1%). Other fairly integrated resource materials include CSI simulation room (50.2%), forensic biology laboratory (46.9%), real objects (46.8%) and forensic chemistry laboratory (37.6%). However, resources such as models (34.4%), specimens (31.3%) and audio materials were integrated at relatively low rates to a great and very great extent.

Table 18: Extent of Use of Instructional Resources (IR) for Learning in BEM (Trainers)

Learning Resource	NE	LE	ME	GE	VGE	Total
Forensic Biology Laboratory	28.1	3.1	21.9	18.8	28.1	100.0
Forensic Chemistry Laboratory	25.0	6.3	31.3	31.3	6.3	100.0
CSI Simulation room	9.4	9.4	31.3	31.3	18.9	100.0
CSI Demonstration room	6.3	3.1	28.1	34.4	28.1	100.0
Audio materials e.g., teleconferencing equipment, speakers	18.8	31.3	18.8	28.1	3.1	100.0
Audio-visual materials e.g., Television, lap top, desk tops	6.3	25.0	15.6	50.0	3.1	100.0
Printed materials e.g., crime scene investigation text books	6.3	3.1	25.0	50.0	15.6	100.0
Real objects/items e.g., hair, bones	6.3	25.0	21.9	31.3	15.5	100.0
Specimens e.g., plant cells, blood samples	9.4	15.6	43.8	21.9	9.4	100.0
Models e.g., casted footprint by use of plaster of Paris.	6.3	12.5	46.9	18.8	15.6	100.0

Key: No extent (NE), Little Extent (LE), Moderate Extent (ME), Great Extent (GE), Very Great Extent (VGE)

Findings imply integration of materials such as printed materials, demonstration and simulation that favour more instructor centered instructional approaches than trainee centered instructional methods. According to Falade (2016), for successful instruction to take place, instructional materials should be adequate and relevant to the subject matter. This is because students learn best from experiential activities involving multiple senses which makes learning more realistic and interesting. The researcher added that a well selected and developed materials provide students with substitutes of real-life materials that may not be availed in the classroom set-up. The study thus proceeded with inferential analysis. Chi Square analysis was used to assess the existing relationship between instructional resources used in scientific training in BEM and the outcome of training in BEM. Table 19 presents the findings.

Sale (2016), carried out a study in Nigeria on the role of instructional resources in instruction of pupils in primary schools. The study found out that instructional materials are significant elements of learning and their role cannot be overlooked. The study observed that materials made teaching and learning interactive and of good quality leading to better results and achievement of learning outcomes. The researcher observed that some teachers were still opposed to use of materials during instruction which hindered quality learning. The study therefore recommended that teachers should

be provided with modern materials and be encouraged to use them during instruction for effective teaching and learning process.

In addition, Azeez et al. (2020) carried out a study in Morocco to assess the impact of using multi-media materials in the instructional process. The study showed that multi-media materials improved pedagogical practices and thus there was effective instruction. The researcher recommended that teachers should adopt the use of multi-media materials to provide multi-sensory experiences to the learners.

Table 19: Relationship between IR and Outcome of Scientific Training in BEM

	Value	Df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	CC
Pearson Chi-Square	14.527 ^a	1	.000			.378
Continuity Correction ^b	12.753	1	.000			
Likelihood Ratio	17.018	1	.000			
Fisher's Exact Test				.000	.000	
Linear-by-Linear Association	14.360	1	.000			
N of Valid Cases	87					

The Chi square results $\chi^2 (1) = 14.527$, $p < 0.001$ showed that there exists a significant relationship between instructional resources for training and the outcome of scientific training on BEM. Contingency Coefficient measure of Association (CC) illustrated that 37.8% of the total variance in the outcome of scientific training in BEM could be attributed to instructional resources for Scientific Training on BEM. Findings therefore led to the rejection of the third hypothesis, H₀₃ which stated that there is no statistically significant relationship between instruction resources and outcome of scientific training on biological evidence management in Nairobi County, Kenya.

Arop et al. (2015) investigated the impact of use of instructional resources on the teaching of science in junior high schools in Nigeria. The study found that utilization of resources had a positive impact on the student's performance which improved remarkably especially in acquisition of basic science concepts. Qualitative data obtained confirmed minimal use of a variety of instructional resources in the scientific training on biological evidence management. Interviewees confirmed use of standard resources such as printed material though minimal use of each of the following:

Simulated crime scenes for practical purposes, forensic biology and chemistry laboratory, audio-visual gadgets for simulations of crime scenes among others.

Findings therefore imply minimal use of varied instructional materials in scientific training on biological evidence management. Utilization of instructional resources such as audio-visual aids and simulations improves the student’s performance as well as sustaining their interest in the learning process. Tutors also use materials to assess students, supplement instruction and harness critical thinking (Amos et al., 2022).

Obonyo, 2013, in Kenya, carried out a study on the integration of ICT in the instructional process in high schools in Homa Bay Data was collected by use of questionnaires and an observation schedule. The results indicated that ICT had not been successfully integrated in teaching and learning in school’s despite of students being capable and motivated to use computers. The majority of teachers were found to have sufficient skills for everyday and routine working practices, but many of them had difficulties in finding a meaningful integration of ICT in teaching and learning.

4.3.4 Relationship between Assessment Methods and Scientific Training on Biological Evidence Management

The fourth objective sought to determine the relationship between assessment methods and scientific training in biological evidence management. BEM trainees and their trainers were provided with statements on training content. Table 20 presents a summary of data obtained from the BEM trainees.

Table 20: Extent of Use of Assessment Methods for Learning in BEM (Trainees)

Assessment method	NE	LE	ME	GE	VGE	Total
Short answer questions	21.8	16.1	26.4	27.6	8.0	100.0
Oral presentations	23.0	8.0	27.6	27.6	13.8	100.0
Essay	38.1	18.4	14.9	13.8	13.8	100.0
Project work	37.9	20.7	17.2	13.8	10.3	100.0
Practical	32.2	11.5	24.1	21.8	10.3	100.0
Term-paper	37.9	11.5	25.3	16.1	9.2	100.0
Assignments	28.7	11.5	32.2	14.9	12.6	100.0
Continuous assessment tests	33.7	9.3	31.4	17.4	8.2	100.0
Mid-course-exams	32.2	17.3	25.3	14.9	10.3	100.0
End-of-course examination	31.1	13.8	26.4	13.8	14.9	100.0

Key: No extent (NE), Little Extent (LE), Moderate Extent (ME), Great Extent (GE), Very Great Extent (VGE)

Information contained in Table 20 show that according to the BEM trainees, oral presentations (41.4%), short answer questions (35.6%) and practical work (32.1%) were the most common assessment methods used in scientific training on BEM to a great and very great extent. Assessment methods such as end of course examinations (28.7%), essays (27.6%), assignments (27.5%) and continuous assessment tests (25.6%) were fairly used for scientific training on BEM to a great and very great extent. Other methods on use but which were not favored include term paper (25.3%), mid-course exams (25.2%) and project work (24.1%) in decreasing order. Table 21 presents findings on use of assessment methods from trainers.

Table 21: Extent of Use of Assessment Methods for Learning in BEM (Trainers)

Assessment method	NE	LE	ME	GE	VGE	Total
Short answer questions	9.4	12.5	28.1	31.3	18.8	100.0
Oral presentations	18.8	9.4	12.5	40.6	18.8	100.0
Essay	21.9	18.8	21.9	25.0	12.5	100.0
Project work	15.6	21.9	31.3	6.3	25.0	100.0
Practical	6.3	15.6	9.4	40.6	28.1	100.0
Term-paper	9.4	28.1	28.1	31.3	3.1	100.0
Assignments	12.5	25.0	21.9	34.3	6.3	100.0
Continuous assessment tests	12.5	34.3	15.6	25.0	12.5	100.0
Mid-course-exams	25.0	37.5	6.3	18.8	12.5	100.0
End-of-course examination	21.9	21.9	15.6	15.6	25.0	100.0

Key: No extent (NE), Little Extent (LE), Moderate Extent (ME), Great Extent (GE), Very Great Extent (VGE)

Data obtained from the trainers show that practical (69.7%) was the most preferred assessment method for scientific training on BEM to a great and very great extent followed by oral presentations (59.4%) and short answer questions (50.1%). Other methods fairly in use to a great and very great extent include end of course examinations (40.6%), assignments (40.6%), essays (37.5%) and continuous assessment tests (37.5%). The remaining methods including term paper (34.4%), project work (31.3%) and mid-course examinations (31.3%) though in use were not preferred to a great and very great extent.

Findings from both BEM trainees and trainers imply that except for practical and oral presentations, there is minimal use of high order formative assessment methods such as project work and term paper to a great and very great extent. Such methods have the

potential of enhancing content mastery in the process of scientific training on BEM. The study thus proceeded to test for existing relationship between assessment methods and outcome of scientific training on BEM. Findings are as shown in Table 22.

Table 22: Relationship between Assessment Method and Outcome of Scientific Training in BEM

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	CC
Pearson Chi-Square	10.172 ^a	1	.001			.325
Continuity Correction ^b	8.775	1	.003			
Likelihood Ratio	10.779	1	.001			
Fisher's Exact Test				.002	.001	
Linear-by-Linear Association	10.053	1	.002			
N of Valid Cases	86					

The Chi square results $\chi^2 (1) = 10.172$, $p = 0.001$ showed that there exists a significant relationship between assessment methods and the outcome of scientific Training on BEM. Contingency Coefficient measure of Association (CC) illustrated that 32.5% of the total variance in the outcome of training in BEM could be attributed to assessment methods for Scientific Training on BEM. Findings therefore led to the rejection of the fourth hypothesis, H_{04} which stated that there is no statistically significant relationship between assessment methods and outcome of scientific training on biological evidence management in Nairobi County, Kenya.

Kibirige and Teffo (2014) in a study entitled actual and ideal assessment practices in South African natural sciences classrooms observed that assessment is one of the most crucial components of any scientific instructional process. Consistent with these findings, Oyinloye and Imenda (2019) in their study on the effect of Assessment For Learning (AFL) on students' achievement in science subjects, students who followed the AFL approach performed better than those who followed the regular classroom instructional methods.

Qualitative data obtained from the QCO indicated that assessment of scientific training on biological evidence management was mainly based on end of course examinations.

According to respondent E:

“The end of course exams predominantly test on crime scene management but disregard of other critical assessment methods.”

In confirming this observation, interviewee H lamented on lack of “proficiency tests and Continuous Assessment Tests” an indication that less formative assessment methods are applied by the CSI trainers.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Summary

Data obtained relative to the relationship between content and outcome of scientific training on biological evidence management confirmed a positive conception of the content for training. Descriptive data of BEM trainees and their trainers illustrated that content was appropriate for biological evidence scientific training in some critical areas. Content was perceived to have adequately provided for concepts such as securing of crime scene, preserving, collecting, labelling, packaging, transportation, storage, analysis and report writing of biological evidence. Qualitative data obtained illustrated that content for training in biological evidence management was inadequate thus enabling the work to be covered in a very short time. Inferential analysis through Chi square showed that there exists a significant relationship between content and the outcome of scientific training in biological evidence management. Contingency Coefficient measure of Association (CC) illustrated that 46.8% of the total variance in the outcome of scientific Training could be attributed to Content for Biological Evidence Management. Findings therefore illustrated a significant relationship between content and scientific training on biological evidence management.

Results relative to the relationship between instructional methods and outcome of scientific training in biological evidence management also confirmed a positive conception of the methods for training. Descriptive findings showed that lecture method was the most preferred method for scientific training on BEM to a great and very great extent according to a majority of the trainees. This means that there was preference for use of teacher centered teaching methods for scientific training on BEM. This was confirmed by interviewees who unanimously agreed that lecture method was the most predominant method used for instruction during scientific training for biological evidence management. Inferential analysis using Chi square showed that there exists a significant relationship between instructional method and the outcome of scientific training on BEM. Contingency Coefficient measure of Association (CC) illustrated that 47.8% of the total variance in the outcome of training on BEM could be attributed to instructional methods for Scientific Training on BEM. This means that the findings

illustrated a significant relationship between instructional methods and scientific training on biological evidence management.

Information was also sought on the relationship between instructional resources and scientific training on biological evidence management. Information obtained from the BEM trainees indicated that printed materials was the most preferred instructional material during training. Findings imply integration of materials that favor more instructor centered instructional approaches than trainee centered instructional approaches. The Chi square results showed that there exists a significant relationship between instructional resources and the outcome of scientific training on BEM. Contingency Coefficient measure of Association (CC) illustrated that 37.8% of the total variance in the outcome of scientific training on BEM could be attributed to instructional resources. Qualitative data obtained confirmed minimal use of a variety of instructional resources in the scientific training on biological evidence management. Specifically, interviewees confirmed minimal use of simulated crime scenes for practical purposes, forensic biology and chemistry laboratory, audio-visual gadgets among others

Descriptive data showed that except for practical and oral presentations, there is minimal use of high order formative assessment methods such as project work and term paper to a great and very great extent. Such methods are credited with the potentiality of enhancing mastery in the process of scientific training on BEM. Chi square results showed that there exists a significant relationship between assessment methods and the outcome of Training in BEM. Contingency Coefficient measure of Association (CC) illustrated that 32.5% of the total variance in the outcome of training on BEM could be attributed to assessment methods for Scientific Training on BEM. Qualitative data obtained from the QCO indicated that assessment of scientific training on biological evidence management was mainly based on end of course examinations. Interviewees lamented about disregard of other critical assessment methods such as proficiency tests and Continuous Assessment Tests.

5.2 Conclusion

The study sought to establish the relationship between pedagogical practices and outcome of scientific training on biological evidence management. The first objective sought to establish the relationship between content and outcome of scientific training on biological evidence management in the study area. Findings from Chi square illustrated a significant relationship between content and scientific training on biological evidence management. Therefore, content is significantly related to scientific training on biological evidence management.

The second objective sought to determine the relationship between instructional methods and outcome of scientific training on biological evidence management. Results from Chi square indicated a significant relationship between teaching methods and outcome of scientific training in biological evidence management. Instructional methods were found to be significantly related to scientific training on biological evidence management.

The third objective sought to establish establish the relationship between instructional resources and outcome of scientific training on biological evidence management. Inferential analysis based on Chi square indicated a significant relationship between instructional resources and scientific training in biological evidence management. Instructional resources are therefore, significantly related to scientific training on biological evidence management.

The fourth and the last objective sought to determine the relationship between assessment methods and outcome of scientific training in biological evidence management. Inferential analysis based on Chi square indicated a significant relationship between assessment methods used and scientific training in biological evidence management. Assessment methods were found to be significantly related to scientific training on biological evidence management. `

5.3 Recommendations

The findings of this study illustrate that selected pedagogical practices such as content, teaching methods, instructional resources and assessment methods are significantly

related to outcomes of scientific training on biological evidence management. The study therefore makes the following recommendations:

- i. Enough lessons should be allocated for biological evidence management training to enable adequate coverage of the diverse content areas and acquisition of skills related to forensic crime scene investigations.
- ii. Crime scene investigation trainers should use more learner centred instructional methods such as practical, project work and presentations in an attempt to improve the instructional process of scientific training on biological evidence management.
- iii. Crime scene investigation trainers should integrate more instructional resources that are more learner centred such as multimedia tools, simulations, models and realia for improved instructional process during scientific training on biological evidence management.
- iv. Crime scene investigation trainers should strive to adopt more formative assessment methods such as project work, term papers and presentations in biological evidence management.

5.4 Suggestions for Further Studies

The study has suggested the following areas for further studies;

- i. This study mainly focused on the relationship between four pedagogical practices; content, instructional methods, instructional resources and assessment methods and scientific training on biological evidence management. Further studies on other practices such as BEM trainee characteristics, BEM trainer's characteristics and institutional related factors such as laws and regulations governing biological evidence, infrastructure and ethical issues are suggested.
- ii. This study mainly focused on the relationship between pedagogical practices and outcome scientific training on biological evidence management. Further studies on actual application of each pedagogical practice by observation are suggested.
- iii. This study focused on scientific training on biological evidence management. Further studies on scientific training on physical evidence management are suggested.

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APPENDICES

Appendix I: Introductory Letter

Martin Mwongera Ithawa,
Chuka University,
P.O Box 106,
Chuka.

Dear Respondent,

I am a student undertaking a course in Master of Education in Science Education from Chuka University, carrying out academic research on: *Relationship between Pedagogical Practices and Outcome of Scientific Training on Biological Evidence Management in Nairobi County, Kenya*. I have selected you as one of my respondents due to your in-depth knowledge and understanding of the area of research. The information you provide will be treated with outmost confidentiality and used entirely for academic purpose. Respondent's identity will be kept anonymous.

Thank you,

Yours faithfully,

Signature

Martin Mwongera Ithawa.

Student

Appendix II: Interview Schedule for Quality Control Officers (QCO)

The questions below will enable the researcher understand more on the scientific training in biological evidence management. Please answer the following questions to the best of your knowledge

1. How long have you been a Quality Control Officer?

2. Comment on the quality of training on biological evidence management that the CSI are given in relation to their work.
(Probe for)
 - a. Content

 - b. Instruction methods

 - c. Instruction resources

 - d. Assessment methods

3. Comment on some of the common challenges to CSI?
(Probe for)
 - a. Securing of crime scene

 - b. Preservation of biological evidence

 - c. Selection of biological evidence

 - d. Collection of biological evidence

 - e. Labelling of biological evidence

 - f. Packaging of biological evidence

- g. Transportation of biological evidence
 - h. Storage of biological evidence
 - i. Analysis of biological evidence
 - j. Biological evidence report writing
4. Do you have any other information you would wish to give to the researcher related to our area of discussion?

Appendix III: Questionnaire for Crime Scene Trainers

PART A: Demographic Information

Please answer the questions by ticking () in the box provided

1. Gender:
Male () Female ()
2. Age:
Below 30 () 30-50 () above 50 ()
3. Level of education:
Certificate () Diploma () Higher diploma () Graduate () Post graduate ()
4. Experience in biological evidence management
Less than 5 years () 5-10 years () above 10 years ()
5. Type of biological evidence management training
Pre-service () In-service () on-the- job training ()
6. Period of scientific training in biological evidence management
1-4 weeks () 5-8 weeks () 3-4 months () 5-8 months () 9 months -1 year () 2-3 years () above 3 years ()
7. Category of biological evidence management scientific training
Local () International () Both ()
8. How often are you taken for refresher or specialized courses/training?
Quite often () after 1-3 years () after 4-6 years () after more than 7 years () Not often ()

The next set of questions are inquiring on your experiences during scientific training in biological evidence management. There are no right or wrong answers. Please read each sentence carefully then tick appropriately the number you have chosen.

PART B: Scientific Training Content in Biological Evidence Management

Kindly indicate the extent to which each of the statements relate to content in biological evidence management scientific training where 1=No extent, 2= Little extent 3- Moderate extent, 4=Great extent 5=very great extent.

Content for training adequately covers	5	4	3	2	1
Securing of crime scene					
Preservation of biological evidence					
Selection of biological evidence					

Collection of biological evidence					
Labelling of biological evidence					
Packaging of biological evidence					
Transportation of biological evidence					
Storage of biological evidence					
Analysis of biological evidence					
Biological Evidence report writing					

PART C: Instructional Methods for Scientific Training in Biological Evidence Management.

Kindly indicate the extent to which each of the following methods of teaching are used during scientific training in biological evidence management where 1=No extent, 2=Little extent 3-Moderate extent, 4=Great extent 5=very great extent.

Method of learning	5	4	3	2	1
Lecture					
Group discussion					
Practical work					
Demonstration					
Presentation					
Mode of learning	5	4	3	2	1
Face-to-face					
On-line					
Face-to-face and on-line					

PART D: Instructional Resources for scientific training in Biological Evidence Management

Kindly indicate the extent to which each of the following resource is used during scientific training in biological evidence management where 1=No extent, 2=little extent 3-Moderate extent, 4=Great extent 5=very great extent.

Learning Resource	5	4	3	2	1
Forensic Biology Laboratory					
Forensic Chemistry Laboratory					
CSI Simulation room					
CSI Demonstration room					
Audio materials e.g. teleconferencing equipment, speakers					
Audio-visual materials e.g. Television, lap top, desk tops					
Printed materials e.g. crime scene investigation text books					
Real objects/items e.g. hair, bones					
Specimens e.g. plant cells, blood samples					
Models e.g. casted footprint by use of plaster of Paris.					

PART E: Assessment Methods for scientific training in Biological Evidence Management.

Kindly indicate the extent to which each of the following method of assessment is used during scientific training in biological evidence management where 1=No extent, 2= Little extent 3-Moderate extent, 4=Great extent 5=very great extent.

SECTION 1

Assessment method	5	4	3	2	1
Short answer questions					
Oral presentations					
Essay					
Project work					
Practical					
Term-paper					
Assignments					
Continuous assessment tests					
Mid-course-exams					
End-of-course examination					

PART F: Outcome of Scientific Training in Biological Evidence Management

Kindly indicate the extent to which training in the following forensic crime scene procedures enable CSI to be competent where 1=No extent, 2= little extent, 3=Moderate extent, 4=Great extent 5=very great extent.

Competency in	5	4	3	2	1
Securing of crime scene					
Preservation of biological evidence					
Selection of biological evidence					
Collection of biological evidence					
Labelling of biological evidence					
Packaging of biological evidence					
Transportation of biological evidence					
Storage of biological evidence					
Analysis of biological evidence					
Writing of biological evidence reports					

Any other information you would wish to give to the researcher

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Thank you for your participation

Appendix IV: Questionnaire for Crime Scene Management Trainees

PART A: Demographic Information

Please answer the questions by ticking in the box provided

1. Gender:
Male () Female ()
2. Age:
Below 30 () 30-50 () above 50 ()
3. Qualifications:
Certificate () Diploma () Higher diploma () Graduate () Post graduate ()
4. What is your area of specialization as per your degree

5. Have ever come across biological evidence during investigations as a police officer?
Yes () No ()
6. Were you trained on biological evidence management then?
Yes () No ()
7. Were you taught on biological evidence management this time during Crime Scene Management subject?
Yes () No ()
8. Lessons for scientific training in biological evidence during Crime Scene Management
1-2 lessons () 3-4 lessons () 5-6 lessons () 8-10 lessons () above 10 ()
9. The period of time for the entire crime scene management subject during your course
Day () 2-3days () 3-5 days () 1week () 2-3weeks ()
10. How often are you taken for refresher or specialized courses/training on crime scene Management as police officers?
Quite often () after 1-3 years () after 4-6 years () after more than 7 years () Not often ()

The next set of questions are inquiring on your experiences during scientific training in biological evidence management. There are no right or wrong answers. Please read each sentence carefully then tick appropriately the number you have chosen.

PART B: Content for Scientific Training on Biological Evidence Management

Kindly indicate the extent to which each of the statements relate to content in biological evidence management scientific training where 1=No extent, 2= Little extent 3-Moderate extent, 4=Great extent 5=very great extent.

Content for training adequately covers	5	4	3	2	1
Securing of crime scene					
Preservation of biological evidence					
Selection of biological evidence					
Collection of biological evidence					
Labelling of biological evidence					
Packaging of biological evidence					
Transportation of biological evidence					
Storage of biological evidence					
Analysis of biological evidence					
Biological Evidence report writing					

PART C: Methods of Scientific Training in Biological Evidence Management.

Kindly indicate the extent to which each of the following methods of teaching are used during scientific training in biological evidence management where 1=No extent, 2= Little extent 3-Moderate extent, 4=Great extent 5=very great extent.

Method of learning	5	4	3	2	1
Lecture					
Group discussion					
Practical work					
Demonstration					
Presentation					

Mode of learning	5	4	3	2	1
Face-to-face					
On-line					
Face-to-face and on-line					

PART D: Instructional Resources in Biological Evidence Management scientific training

Kindly indicate the extent to which each of the following resource is used during scientific training in biological evidence management where 1=No extent, 2=little extent 3-Moderate extent, 4=Great extent 5=very great extent.

Learning Resource	5	4	3	2	1
Forensic Biology Laboratory					
Forensic Chemistry Laboratory					
CSI Simulation room					
CSI Demonstration room					
Audio materials e.g., teleconferencing equipment, speakers					
Audio-visual materials e.g., Television, lap top, desk tops					
Printed materials e.g., crime scene investigation text books					
Real objects/items e.g., hair, bones					
Specimens e.g., plant cells, blood samples					
Models e.g., casted footprint by use of plaster of Paris.					

PART E: Assessment Methods in Biological Evidence Management scientific training.

Kindly indicate the extent to which each of the following method of assessment is used during scientific training in biological evidence management where 1=No extent, 2= Little extent 3-Moderate extent, 4=Great extent 5=very great extent.

Assessment method	5	4	3	2	1
Short answer questions					
Oral presentations					
Essay					
Project work					
Practical					
Term-paper					
Assignments					
Continuous assessment tests					
Mid-course-exams					
End-of-course examination					

PART F: Outcome of Scientific Training

Kindly indicate the extent to which scientific training enable CSI to be competent where 1=No extent, 2= little extent, 3=Moderate extent, 4=Great extent 5=very great extent.

Competence in	5	4	3	2	1
Securing of crime scene					
Preservation of biological evidence					
Selection of biological evidence					
Collection of biological evidence					
Labelling of biological evidence					
Packaging of biological evidence					
Transportation of biological evidence					
Storage of biological evidence					
Analysis of biological evidence					
Writing of biological evidence reports					

Any other information you would wish to give to the researcher

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Appendix V: Table for Determining Sample Size

N	S	N	S	N	S	N	S	N	S
10	10	100	80	280	162	800	260	2800	338
15	14	110	86	290	165	850	265	3000	341
20	19	120	92	300	169	900	269	3500	346
25	24	130	97	320	175	950	274	4000	351
30	26	140	103	340	181	1000	278	4500	354
35	32	150	108	360	186	1100	285	5000	357
40	36	160	113	380	191	1200	291	6000	361
45	40	170	118	400	196	1300	297	7000	364
50	44	180	123	420	201	1400	302	8000	367
55	48	190	127	440	205	1500	306	9000	368
60	52	200	132	460	210	1600	310	10000	370
65	56	210	136	480	214	1700	313	15000	375
70	59	220	140	500	217	1800	317	20000	377
75	63	230	144	550	226	1900	320	30000	379
80	66	240	148	600	234	2000	322	40000	380
85	70	250	152	650	242	2200	327	50000	381
90	73	260	154	700	248	2400	331	75000	382
95	76	270	159	750	254	2600	335	100000	384

Note: N is population size; S is Sample Size

Source: Krejcie & Morgan (1970)

Appendix VI: Regional Director of Education Authorization



Republic of Kenya

MINISTRY OF EDUCATION STATE DEPARTMENT OF BASIC EDUCATION

Telegrams: "SCHOOLING", Nairobi
Telephone: Nairobi 020 2453699
Email: rcenairobi@gmail.com
cdenairobi@gmail.com

REGIONAL DIRECTOR OF EDUCATION
NAIROBI REGION
NYAYO HOUSE
P.O. Box 74629 – 00200
NAIROBI

When replying please quote

Ref: RDE/NRB/RESEARCH/1/65 Vol.1

Date: 4th March, 2023

Martin Mwongera Ithawa
Chuka University

RE: RESEARCH AUTHORIZATION

We are in receipt of a letter from the National Commission for Science, Technology and Innovation regarding research authorization in Nairobi County on the topic: Relationship between scientific training in Biological Evidence Management and outcome of forensic crime scene procedures.

This office has no objection and authority is hereby granted for a period, ending 25th March, 2024 as indicated in the request letter.

Upon completion, you are advised to share your research findings with this and other relevant offices.

DR. PETER KIRIKA
FOR: REGIONAL DIRECTOR OF EDUCATION
NAIROBI.



Appendix VII: Ethics Approval Letter



CHUKA UNIVERSITY INSTITUTIONAL ETHICS REVIEW COMMITTEE

Telephones: 020-2310512/18

P. O. Box 109-60400, Chuka

Direct Line: 0772894438

Email: info@chuka.ac.ke,

Website: www.chuka.ac.ke

REF: CUIERC/ NACOSTI/338

1st March, 2023

TO: Martin Mwongera Ithawa

RE: Relationship between Scientific Training in Biological evidence management and Outcome of Forensic Crime Scene procedures in Nairobi County, Kenya

This is to inform you that *Chuka University IERC* has reviewed and approved your above research proposal. Your application approval number is *NACOSTI/NBC/AC-0812*. The approval period is 1st March, 2023 – 1st March, 2024.

This approval is subject to compliance with the following requirements;


- i. Only approved documents including (informed consents, study instruments, MTA) will be used
- ii. All changes including (amendments, deviations, and violations) are submitted for review and approval by *Chuka University IERC*.
- iii. Death and life threatening problems and serious adverse events or unexpected adverse events whether related or unrelated to the study must be reported to *Chuka University IERC* within 72 hours of notification
- iv. Any changes, anticipated or otherwise that may increase the risks or affected safety or welfare of study participants and others or affect the integrity of the research must be reported to *Chuka University IERC* within 72 hours
- v. Clearance for export of biological specimens must be obtained from relevant institutions.
- vi. Submission of a request for renewal of approval at least 60 days prior to expiry of the approval period. Attach a comprehensive progress report to support the renewal.
- vii. Submission of an executive summary report within 90 days upon completion of the study to *Chuka University IERC*.


Prior to commencing your study, you will be expected to obtain a research license from National Commission for Science, Technology and Innovation (NACOSTI) <https://oris.nacosti.go.ke> and also obtain other clearances needed.

Yours sincerely

Dr. Benjamin Kanga
SECRETARY


Appendix VIII: National Commission for Science, Technology and Innovation (NACOSTI) Research Permit


REPUBLIC OF KENYA


NATIONAL COMMISSION FOR SCIENCE, TECHNOLOGY & INNOVATION.

Ref No: **667212** Date of Issue: **25/March/2023**


RESEARCH LICENSE




This is to Certify that Mr. MARTIN MWONGERA ITHAWA of Chuka University, has been licensed to conduct research as per the provision of the Science, Technology and Innovation Act, 2013 (Rev.2014) in Nairobi on the topic: RELATIONSHIP BETWEEN SCIENTIFIC TRAINING IN BIOLOGICAL EVIDENCE MANAGEMENT AND OUTCOME OF FORENSIC CRIME SCENE PROCEDURES IN NAIROBI COUNTY, KENYA for the period ending : 25/March/2024.

License No: **NACOSTI/P/23/24401**

667212
Applicant Identification Number


Director General
NATIONAL COMMISSION FOR SCIENCE, TECHNOLOGY & INNOVATION

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See overleaf for conditions