CULTURAL ARTEFACTS AND BIOLOGY INSTRUCTION IN PUBLIC SECONDARY SCHOOLS IN MERU SOUTH SUB-COUNTY, THARAKA-NITHI COUNTY, KENYA

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CHUKA UNIVERSITY

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DECLARATION AND RECOMMENDATIONS

Declaration

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

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Recommendations

This thesis has been examined, passed and submitted with our approval as University supervisors.

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DEDICATION

This work is dedicated to my dear family for the immense support and encouragement during the study period. To my dear wife Lenah, thank you for keeping me awake and for your understanding. To my son Mwenda and daughter Leslie, thank you for your encouragement. All your efforts were not in vain. May the almighty God bless you abundantly.

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May almighty God bless you all.

ABSTRACT

Biology education in Kenya has been characterized by persistent poor performance in national examinations. This has resulted in a majority of students transiting the secondary school cycle being locked out of courses that require above average performance in the subject. The persistent poor performance in Biology is attributed to a number of reasons such as adoption of inappropriate teaching approaches. One of the reasons advanced for adoption of such approaches has been lack of adequate and appropriate teaching and learning resources due to limited financial resources in most public schools. In the absence of adequate resources, Biology teachers have been encouraged to use community resources within their surrounding including cultural artefacts for instructional purposes. To date however, minimal empirical literature specific to types, frequency as well as influence of use of cultural artefacts on Biology instruction exist. This study therefore sought to address the existing knowledge gap by assessing the types, frequency and influence of cultural artefacts on Biology instruction with a specific focus on public secondary schools in Meru south sub-county. It also sought to establish the challenges that Biology teachers face when using cultural artefacts. The study was based on Constructivist learning theory and socio-cultural theory. It applied a descriptive survey research design which incorporated both qualitative and quantitative approach. The target population was heads of Biology subject, Biology teachers and forms four Biology students in public secondary schools in the Sub County with a population of 4192. The sample size of 351 respondents was determined using the sample table developed by Krejcie and Morgan. Data collection instruments were a questionnaire with closed ended questions covering the study objectives for form four Biology students and their Biology teachers as well as interview schedule for heads of Biology subject. Face, content and construct validity of the instrument was ascertained to ensure that the instruments met the required threshold with the help of the supervisors. Reliability of the instruments was assessed using Cronbach's Alpha from the pilot data obtained from selected schools in Maara Sub-County, reliability coefficient of the variables ranging between 0.685 and 0.928 which was considered to be within the 0.7 acceptable threshold. Data obtained was analyzed using descriptive and inferential statistics with the aid of Statistical Package for Social Science (SPSS) version 26 computer software. The study findings showed that bones from skeletons of animals, beads and necklaces, wood carvings and skins, stones, mud huts, clay pots, baskets and basketry, music instruments and iron metal are some of the cultural artefacts used in Biology instruction in varying degree. The study also illustrated that use of cultural artefacts positively and significantly influences Biology instruction even though inadequacy of cultural artefacts, negative cultural beliefs and myths associated with use of some artefacts and difficulties to relate some artefacts with biological concepts continue to limit use of the artefacts in Biology instruction. It is therefore recommended that Biology teachers be encouraged to enhance the use of artefacts in instruction as well as teachers and students to be sensitized on the positive outcomes of using the artefacts as instructional materials.

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ACRONYMS AND ABBREVIATIONS

ASEI:	Activity, Student, Experiment, Improvisation
CDE:	County Director of Education
HOS:	Head of Subject
INSET:	In-Service Education and training
KCSE:	Kenya Certificate of Secondary Education
KICD:	Kenya Institute of Curriculum Development
KNEC:	Kenya National Examinations Council
KUCCPs:	Kenya Universities and Colleges Central Placement Services
MDGs:	Millennium Development Goals
MOE:	Ministry of Education
NACOSTI:	National Commission for Science Technology and Innovation
PDSI:	Plan, Do, See, Improve
SMASSE:	Strengthening of Mathematics and Science in Secondary Education
SPSS:	Statistical Package for Social Science
STEM:	Science Technology Engineering and Mathematics
UV:	Ultra-Violet

CHAPTER ONE
INTRODUCTION

1.1 Background of the Study

Biology instruction is a critical component of any comprehensive education system. It belongs to the family of Science, Technology, Engineering and Mathematics (STEM). This is significant for promoting socio- economic and technological advancement which for Kenya implies attainment of development target including vision 2030. As a process, Biology instruction entails preparation, presentation and evaluation of teaching and learning of Biology concepts. According to Chavan & Patankar (2018), the concepts are important in that they help in understanding the basics of Biology, appreciating the diversity of organisms, developing critical thinking skills and applying Biological principles to everyday life. Similarly, Ong'amo, Ondigi and Omariba (2017) contend that Biology concepts lay a foundation for careers in human medicine, public health, agriculture, veterinary medicine, animal husbandry and biotechnology. The overall assumption is that mastery of Biology concepts which is the main objective of Biology instruction is improved human and animal health as well as food security. This means that Biology instruction is so important in the society for it touches on peoples' lives and their way of living.

However, and despite its importance, evidence shows that a majority of learners continue to face challenges in mastery of Biology concepts. This often results in poor performance in the subject both in internal and external examination in many parts of world (Joy & Dinah, 2014; Adewale, Nzewuihe, & Ogunshola, 2016). In agreeing with this observation, Wamukota and Masibo (2017) pointed out that performance of a majority of learners in Biology is poor despite the key role the subject plays in industrialization and other sectors of the economy environment. MOE (2018) in concurrence reviews that despite the rich supply of materials such as text books in schools, students performed poorly in Biology over the decade in Kenya. In South Africa (Ngema 2016) made a similar observation that there was poor performance in science subjects and it became a threat to the country's development and the economy. A study by Og'ambo (2014) revealed that teaching and learning resources were not adequately used in Biology in Kenya and this affected students' academic achievement.

Data obtained from Kenya National Examination Council (KNEC) on students' performance in the subject confirm that in the last five years, students' performance in Biology has remained low nationally and at the sub county level in Meru South Sub-County (KNEC 2021). Table 1 provided information on the performance of KCSE candidates in STEM subjects for the period of 2017 to 2021 nationally.

Table 1: National KCSE Results for STEM Subjects (%)

Year	Biology	Chemistry	Physics	Mathematics
2017	18.93	24.05	35.05	25.47
2018	25.69	26.88	34.27	26.44
2019	25.54	26.09	35.09	27.54
2020	26.50	24.05	35.04	18.36
2021	27.02	25.08	34.01	20.25

Source: KNEC (2021).

Table 1 indicates that Biology had the lowest percentage mean rating in 2017, 2018 and 2019 when compared to other STEM subjects. Specifically, mean rating of students' performance in the subject ranged between 18.93% in 2017 and 27.02% in 2021 implying that a majority of students transiting the secondary school phase failed to get the minimum grade of C (45-54%) grade in the subject required by Kenya University and Colleges Central Placement Services (KUCCPS) for placement in a Biology related career in higher institutions of learning. This means that not only do KCSE graduates fail to enroll to this important career options but also the country fails in attaining its Millennium Development Goals (MDGs) of having a highly trained and skilled workforce in specific STEM related areas such as Biological sciences and related areas. A similar trend in performance was observed for Biology subject in Meru South Sub County as seen in Table 2.

Table 2: Meru South Sub County KCSE STEM Subjects

Year	Biology	Chemistry	Physics	Mathematics
2018	2.94	3.19	4.10	2.98
2019	3.03	2.73	3.89	3.01
2020	2.77	2.26	3.73	2.29
2021	3.14	2.09	2.83	2.46
2022	2.62	2.38	2.77	1.79

(Mean Rating out of 12 Points).
Source: Meru South Sub County Director of Education Office (2022).

Table 2, shows that similar to the national averages, Biology performance of Meru South students in KCSE exam within the same period ranged between mean rating of 2.62 in 2022 to 3.14 in 2021. Findings show that a majority of students failed to score the minimum grade required for placement in Biology related careers thus jeopardizing their future career prospects. Data obtained illustrated that there was need for studies not only highlighting the causative factors for the persistent poor performance but also probable remedial action whose implementation could provide a remedy to the problem.

Empirical evidence attributes persistent poor performance to a number of reasons that hinder mastery of Biological concepts during Biology instruction thus resulting in poor performance. A study by Almuammria (2015) revealed that there are a range of factors affecting academic performance such as learner factors, family factors and school factors. According to Ndayambaje, Bikorimana and Nsanganwimana (2021), the root causes of poor performance in Biology are abstract Biological concepts, learner characteristics and their attitude towards the subject, inappropriate teaching methodology, insufficient teaching and learning facilities and materials among others. Similarly, Atilla (2012) on the topic "what makes Biology learning difficult'' leading to poor performance in the subject identified; nature of topics, teachers' style of teaching, students' learning and studying habits, students negative feeling and attitude towards the subject and lack of resources. To overcome these difficulties and make learning more effective, the participants suggested such strategies as teaching Biology through use of visual materials, reducing contents of Biology curriculum, teaching through practical work and using various study techniques, teaching Biology through connecting the topics with daily life, making Biology learning interesting. Michira (2017) attributes the dismal performance in Biology to the change in exam setting noting that the nature of current examination requires analytical skills unlike memorization that characterized earlier examinations. This may be explained by the limitation of use of conventional methods of teaching which do not enhance development of analytical skills. The studies identified the most common factors predicting students' poor performance in Biology to be content related factors, teaching methodology, teacher related factors, learner related factors and inadequate resources for Biology instruction.

In an attempt to curb persistent poor performance of a majority of learners in Biology, the government of Kenya through the ministry of education in collaboration with other stakeholders proposed and adopted a number of interventions. Some of these interventions includes; curriculum review and rationalization to reduce the load on both students and teachers, training of Biology teachers through SMASSE and recruitment of more Biology teachers to improve on student teacher ratio for effective delivery of concepts (Ndirangu, Nyagah & Kimani, 2017). Other interventions proposed and implemented include strengthening of quality assurance to improve monitoring of curriculum implementation and supervision as well as expansion of infrastructure in schools.

Even after such interventions, data available indicate that performance in KCSE in Biology nationally and in Meru South Sub County continue to be poor. This means the interventions undertaken so far may not have adequately remedied the factors leading to students' poor performance in the subject. One possible explanation for this is inadequate financial resources required to adequately in-service teachers and improves teaching and learning facilities. This may be due to constrained financial resources for the education sector and in particular public secondary school in Kenya (Mutua, Chiriswa, & Thinguri, 2014). As a matter of fact, a majority of public secondary schools still find themselves constrained in providing quality teaching due to limited teaching and learning resources since provision of such resources adequately requires sufficient funding. In the absence of adequate resources, teachers are increasingly being encouraged to improvise by designing and developing instructional resources especially from locally available materials (Ibrahim, Mohammed, Abdullahi, Uzoma, & Bizi, 2021). Additionally, teachers are encouraged to use community resources available within their immediate vicinity for instructional purposes. Some of these materials are cultural artefacts which are unique and have a cultural meaning to a particular community within which the school exists.

Cultural artefacts are objects that are of importance to a cultural group. They are uniquely identified with a cultural group, usually because they are a product of culture (Mackey, Drew, Nicoll-Senft & Jacobson, 2023). According to Wartofsky (2022), cultural artefact is a term used in social sciences, particularly anthropology, ethnology

and sociology for anything created by humans which gives information about the culture of its creator and user. It offers an insight into technological processes, economic and social structure of the cultural group. They are of critical importance to the study of humans and civilization over the course of history. Artefacts are the concrete items cultures leave behind. Cultural artefacts are anything such as objects, writing and artwork which give information about people and the culture by which the artefact was used. Cultural artefacts create engagement in various levels, even in school that might have limited funding or materials. Cultural artefacts can be used in any lesson activity, pre or post assessment to further develop an idea or topic, to make real life connections to a lesson topic or even to engage students in a lively discussion or a small group activity. There is a pool of materials at the fingertips of any willing teacher to learn how they can best use artefacts in a lesson or unit activity. By bring hands on learning tools into classrooms the leaners have a chance to change how they perceive their own education and the school environment as a whole.

According to Taylor (2012), in a study of inquiry-based approaches using artefacts in Biology teaching in United Kingdom, artefacts were observed to play an important role in creating a learning environment in which students can comprehend and enjoy learning Biology. The study used a descriptive research design, and the target population was 148 primary schools with a sample size of 62 schools sampled using a convenience sampling procedure. The study variables were empirically tested using bivariate correlation analysis. The bivariate correlation coefficient was 0.513, which was significant ($p < .001$). The model results also revealed that with all other variables held constant, an increase in adoption of inquiry-based approaches using artefacts would result in a 0.456 ($p=.002$) increase in educational participation. The review process resulted in a list of 109 different terms for inquiry phases. These terms showed considerable overlap, which became evident when comparing the descriptions of the phases. The study observed that students became more interested with some topics when cultural regalia and school available artefact tools were applied. Therefore, such artefacts influence learning than other instructional materials both in class and in the laboratory which fills the void in disseminating required information.

In an equivalent observation by Hocking (2020) in the study of Australian Biology curriculums using artefacts, students were able to make sense of their own and families' development. The study used mixed methods of data collection, including forming group discussions, informal and many important events and development occurring in the environment and in the world around them, interviews and questionnaires. The study's methodology was descriptive in nature. The target population was 374 primary schools and a sample of 112 schools which was 30% of the target population. The reliability of the research instruments was calculated using the test-retest method. Quantitatively data was analyzed using descriptive statistics and Pearson r tested the hypothesis. Results show that there was a significant relationship between subjects such as nutrition and health.

An observation was also made by Kroes and Meijers (2016) in Brazil while teaching Biology. The scholars observed that teaching Biology in a classroom or in the laboratory requires elaborate and sometimes tangible objects which create a multi-faceted environment. This culminates to an effective teaching and learning taking place and is important in terms of teacher- student interaction and communication. The study adopted the survey research design. The hypothesis tested was; that there are no statistically significant determinants between the laboratory and tangible items when teaching Biology in a classroom. The population of the study consisted of (n= 231) Montanoria's County Public Schools in Brazil. The reliability of the questionnaire was ascertained through the test-retest technique and the scales were reliable as their reliability values exceeded the prescribed threshold of 0.7. Multilevel logistic regression was used to analyze the impacts of teaching Biology in a classroom in the laboratory. The study indicated that it requires elaborate and sometimes tangible objects which create a multi-faceted environment in order for an effective teaching of Biology subjects. The essential elements for creating a multi-faceted learning environment required interesting and mind capturing equipment for students to internalize.

DeVries (2022) observes that cultural or students made artefacts create a synthesis of qualitative and quantitative approaches. The Mann-Whitney test was used to compare the median of artefacts use while, chi-square tests and logistic regression models were

used to estimate the likelihood of application by teachers in Biology classes. Validity of the questionnaire was ensured through expert judgment and adjustments were made accordingly before the actual data collection was undertaken. Cronbach's Alpha was used to test the reliability of questionnaire items and the cutoff point was acceptable which can create a conducive environment in a Biology class. The study used mixed method research a reliability of 0.7. The obtained Cronbach's Alpha for the two variables in question ranged between 0.887 to 0.962 meaning the items were reliable for data collection. The study found out that, the amount of artefacts pupils encounter every day is almost endless. Besides that, the educational effort made to make them understand those artefacts would soon be outdated, as new artefacts constantly enter our lives. Further, the study indicated that without an understanding that exceeds the individual artefact, each bit of knowledge about a particular artefact soon becomes less relevant because new artefacts have taken the place of old ones. The study concluded that the way artefacts are presented in education should be such that pupils learn to recognize characteristics of the artefact that are not specific for one specific artefact, but that relate to the very nature of all technical artefacts. Although the above studies were conducted in different cultural setting and learning environment, the above observations can be replicated in the study scope to make Biology concepts interesting.

A study by Arop, Umanah and Effiong (2015) in Nigeria, focused on teaching students the 21st century skills. The study examined the role of instructional materials in the science classroom and how instructional materials have affected the teaching and learning of Basic Science. The study employed quasi experimental design. Two research questions and two hypotheses guided the study. In the study, 240 students were randomly selected by simple ballot method from four secondary schools in Biase Local Government Area of Cross River State. A 20-item test called Diffusion Achievement Test [DAT] constructed by the researcher was used to collect data for the study. The test had a reliability of 0.86. Scores generated from pre-test and post-test were analyzed using mean, standard deviation and independent t-test. The result showed that the use of instructional materials has a favorable effect on students' achievement in science concepts.

In a related study in Nigeria, Nnorom and Okoli (2014) and Ghumdia (2016) found that artefacts teaching materials had a distinctive importance for the teachers to design effective and interactive teaching environments for the individuals to gain qualifications required. Nevertheless, concrete objects could help students gain access to concepts and processes that might otherwise remain inaccessible. The study used pre-test, post-test, control group; quasi-experimental design with 2x2x2 factorial matrix was adopted. One hundred and twenty SS2 students from six purposively selected senior secondary schools in three local government areas of Oyo state were used for the study. The schools were randomly assigned to experimental and control groups while the study lasted for fourteen weeks. Four instruments used for data collection were; Teachers Instructional Guides for teachers using the one treatment and control group, Students Environmental Achievement Test (r = 0.80), Mental Ability Test (r = 0.81) and Assessment Sheet for evaluating research assistants. Two null hypotheses were tested at 0.05 level of significance. Data collected was analyzed using Analysis of Covariance (ANCOVA). It was recommended that inquiry strategy could improve achievement taking into cognizance the mental ability and gender of students concerned.

Fakoyede, (2018) study on impact of cultural artefact in teaching Mathematics in Ghana observed that in order to facilitate learning, it is paramount for teachers and learners to relate science to their lived world or their culture. The study employed a qualitative descriptive research design. Purposive sampling was used to select the respondents. Semi-structured interviewing techniques were utilized to gather the data which was then analyzed thematically. Validity of the questionnaire was ensured through expert judgment and adjustments were made accordingly before the actual data collection was undertaken. Cronbach‘s Alpha was used to test the reliability of questionnaire items and the cutoff point was acceptable with a reliability of 0.7. The obtained Cronbach‘s Alpha for the two variables in question ranged between 0.732 to 0.961 meaning the items were reliable for data collection. The study found out that when artefacts were applied students grasped mathematical concept more easily than in traditional teaching. In this sense, artefacts allowed students to establish connections between their everyday experiences and their nascent knowledge, concepts and symbols.

Furthermore, Mukagihanna, Nsanganwimana and Aurah (2020) carried a study on Biology instructional resources availability and extent of their utilization in teaching pre-service Biology teachers. The study indicated that people from Rwanda have vibrant cultural artefacts extremely rich in diversity which may be used in Biology instruction for better concepts understanding. The study aimed to identify the types of available Biology instructional resources and their frequency of use in teaching pre-service Biology teachers. The study used a descriptive survey research design and was conducted in three private Universities selected from those offering education in Rwanda. Eighty-two pre-service Biology teachers and five Biology lecturers participated in the study. Observational checklist of Biology instructional resources and questionnaires aided the collection of data analyzed by frequency counts and percentages. The findings revealed that Biology instructional resources like classroom chairs, chalkboards, laboratories, microscopes, centrifuge, slide projectors, Biology textbooks were available while resources like a class whiteboard, classroom overhead projectors, electrophoresis unit, recorders, Polymerase chain reaction machines, among others, were absent. The findings also revealed low-level use of available Biology instructional resources in teaching pre-service Biology teachers. The implication is the likelihood of producing less competent future Biology teachers. The provision of adequate Biology instructional resources, as well as the monitoring of their use in teaching Biology, was recommended. The outcome can be based on learner-centered and activity oriented approach. The activities or practices that take place in various communities and the cultural artefacts that are found there is a true reflection of many communities (Krohs & Kroes, 2019). Comparatively, it is possible that these artefacts can be presented in the classroom and analyzed by learners and teachers together to come up with Biology subject concepts in secondary schools in Meru South Sub County.

According to Orodho, Waweru, Getange and Miriti (2013), as pertains to the effects of instructional tools on students' performance at KCSE in Subukia Sub-District, Nakuru County, artefacts had great impact on performance. The study used a one-time post-evaluation with a mixed methods approach. Twelve focus groups and 28 key informant interviews with government and educational personnel, parents, cooks, and cooperative members were used to gather qualitative data. The quantitative portion used cross-sectional data gathered from 1512 children in 30 pilot schools and 30

control schools, with the application of quasi-experimental methodology. The study showed that, it is somehow evident that the education systems in Kenya may be raising individuals who are not well equipped due to lack of instructional materials. The issue can be remedied by relying on cultural artefacts instead of IT tools for education purposes.

Further, Ong'amo, Ondigi and Omariba (2017), undertook a study on effects of utilization of Biology teaching and learning resources on students' academic performance. The study was carried out in public secondary schools in Siaya District and used a sample of twenty-three schools that was drawn from ninety-two public secondary schools. They were selected through stratified random sampling. The teacher respondents were purposively or randomly sampled. Purposive sampling was used to choose an experienced teacher where two or more teachers taught Biology in form two classes and the teacher was the most experienced. Where there existed more than one long serving and experienced teachers teaching form two classes, random sampling was employed to pick one of them for interview. Student respondents were chosen through random sampling in single sex schools and stratified random sampling in mixed schools. Head teachers from each of the sampled schools were selected for personal interview. The data was collected using questionnaires, checklists, observation schedules and interview guides for head teachers. Observation schedules were used by the researcher to ascertain use of resources by teachers and learners and the resultant tests used to determine the score differences in achievement between classes taught using resources and those taught without resources. The findings were that educational artefact tools in Kenya may include objects used in classroom such as cultural regalia, artefacts made by teachers, curriculum materials and learner's products. The study established that textbooks were the most widely used teaching and learning resources while audio visual resources were the least used. The resources were mainly bought by the head teachers and very few improvised by teachers. The textbooks in schools were inadequate and had to be shared by students who could not buy their own or borrow from friends. It was also observed that schools that were endowed with abundant resources were performing much better than those schools with few resources.

1.2 Statement of the Problem

Students' performance of Biology subject has been characterized by poor performance in national examinations especially in Meru South Sub County, Kenya. Information obtained for the past five years shows that performance in Biology has continued to be poor, implying that a majority of students transiting the secondary school cycle continue to be locked out of courses that require above average performance. Students are required to attain a mean of (C+) in Biology subject to enroll in courses of human medicine, Pharmacy, Animal Science among others which is a challenge in transition to higher level of leaning. Notable is that between 2017 and 2018 over 98 per cent of students scored below the C+ pass mark in Biology, with 95 per cent scoring below the pass mark in 2020. The persistent poor performance in Biology was attributed to poor coverage of the syllabus, failure to understand questions, theoretical teaching and lack of mastery of concepts.

In an effort to reverse the trend of poor performance in Biology, the government of Kenya through the Ministry of education in collaboration with other stakeholders proposed and adopted a number of interventions targeting learners, instructors and overall instruction. These interventions include; curriculum review, training of Biology teachers through SMASSE, recruitment of more Biology teachers, strengthening of quality assurance department as well as expansion of infrastructure in schools. Despite these interventions, performance in Biology subject in KCSE in the country and in Meru South Sub County has generally remained poor. One of the reasons for poor performance in Biology was attributed to inadequate financial resources required to procure adequate teaching and learning resources. In the absence of adequate resources, Biology teachers were encouraged to use community resources within their surrounding including cultural artefacts for instructional purposes. To date however, minimal empirical literature is specific to types, frequency as well as influence of use of cultural artefacts on Biology instruction exist. The study therefore sought to assess the types, frequency and influence of cultural artefacts on Biology instruction with a specific focus on public secondary schools in Meru south sub-county as contribution to the existing knowledge gap.

1.3 Purpose of the Study

The purpose of the study was to find the types, frequency and influence of use of cultural artefacts in Biology instruction in public secondary schools in Meru south sub-county. The study also sought to establish challenges teachers face in using those cultural artefacts in Biology instruction.

1.4 Objectives of the Study

i. To explore the types of cultural artefacts used in Biology instruction in Meru South Sub-County, Kenya.
ii. To establish the frequency of use of various types of cultural artefacts in Biology instruction in Meru South Sub- County, Kenya.
iii. To determine the influence of use of cultural artefacts on Biology instruction in Meru South Sub- County, Kenya.
iv. To establish challenges teachers face in using cultural artefacts in Biology instruction in Meru South Sub-County, Kenya.

1.5 Research Questions

The study sought to answer the following research questions

i. What are the types of cultural artefacts used in Biology instruction in secondary schools in Meru South Sub County?
ii. What is the frequency of use of various cultural artefacts in Biology instruction in Meru Sub County?
iii. What is the influence of cultural artefacts on Biology instruction in Meru South Sub County?
iv. What challenges are faced by teachers while using cultural artefacts in Biology instruction in Meru sub-county?

1.6 Significance of the Study

The study findings may provide useful information to stakeholders such as the Ministry of Education and Kenya Institute of Curriculum Development (KICD) as policy formulators, Teacher Training Institutions, school administrators, teacher of Biology as policy implementer and Biology students, Researcher and curriculum Support Officer as beneficiaries and in monitoring and evaluation. The study findings

may be of paramount importance to the Ministry of Education in Kenya when shaping curriculum for in- service programme for secondary school teachers (INSET). The study findings serve to improve Biology subject performance in secondary schools in Kenya and more specifically in Meru South Sub-County in the national examinations. The study establishes the use of culturally based artefacts per communities in Kenya which can be used in teaching and learning of Biology subjects respectfully. The study would also try to establish whether the cultural artefacts used influence Biology instruction in secondary schools. The study findings may be applied by the KICD when developing Biology curriculum for teachers on instructional materials in teaching Biology in secondary schools in Kenya. Training institutions will benefit from findings especially the role of cultural artefacts in the instructional process thus helps in preparation of prospective Biology teachers. The study also serves as an eye opener to schools' administration to install and implement relevant school policies which would include facilitating in acquisition and utilization of cultural artefacts in Biology. Students will benefit from improved pedagogical process emanating from the study and ultimately improved performance in Biology and related STEM subjects. The study adds knowledge to the current and existing framework in the areas of Biology instruction in secondary schools which will be useful to future researchers.

1.7 Scope of the Study

This study was based on public secondary schools in Meru South Sub-County and targeted both Biology teachers and four Biology students. Biology teachers as the implementers of Biology curriculum were considered important due to their knowledge and experience of subject matter under discussion. Form four Biology students were also included being the cohort with the longest period of exposer to Biology curriculum thus are the best acquitted with both theory and practical experience in Biology subject. Meru South Sub County was considered ideal study locale due to inadequate resources experienced by a majority of public secondary schools within the sub-county and attendant student poor performance in Biology.

1.8 Assumptions of the Study

The study was based on the following assumptions;

i. That there were various types of cultural artefacts that can be used in Biology instruction in Meru South Sub-county.
ii. That Biology teacher and form four Biology students provided correct and reliable information on the frequency and influence of use of various types of cultural artefacts in Biology instruction.
iii. That Biology teacher provided authentic information on challenges teachers face in using cultural artefacts in Biology instruction in Meru South Sub-county.

1.9 Limitation of the Study

These are shortcomings, conditions or influences that cannot be controlled by the researcher and may have a negative outcome on literature sources, methodology and conclusions. (Tromp, 2016). Study methodology may obtain more quantitative data as compared to the qualitative data and this challenge may be overcomed by combing the two methods of data collection. On literature review, few studies have been done on the topic and therefore the researcher is unable to obtain enough information on review of the topic. To overcome the challenge, the researcher may vary the methods for sourcing literature including obtaining it from the library. In the study, confidentiality of the information given may be a challenge because the teachers may have not been using cultural artefacts resources, thus, fearing victimization. This challenge may be overcomed by the researcher making concerted effort to assure the respondents that the information provided will be treated with outmost anonymity and confidentiality.

1.10 Operational Definition of Terms

The following are the key operational terms used in the study.

Artefacts: Artefacts are simple objects such as a tool or ornament showing human workmanship or modification. In this study artefacts are the learning resources which can be sourced or created by students during the course of instruction to study Biology subject.

Biology Instruction: A process that entails preparation, presentation and evaluation of teaching and learning of Biology concepts. In this study the term refers to teaching and learning methods in Biology subject.

Cultural Artefacts: These are objects created or modified by humans which give information about the culture of their creator and users. As per this study, these are locally available cultural materials such as pottery, collage, weaved material, beads, bones etc.

Instructional Material: Instructional materials are teaching and learning materials. In this study they include cultural artefacts locally produced, sourced or any other collections which can be applied in Biology subject.

Inquiry based learning: Inquiry-based leaning is a student-centered approach where the instructor guides the students through questions posed, methods designed, and data interpreted by the students. In the current study the terms refers to the instructional method where students actively discover information to support their investigations.

Traditional Methods of Teaching: The traditional method of teaching is a teacher-centered method that promotes the supremacy of the teacher within the classroom setup. In the current study the term refers to traditional methods of teaching Biology which is characterized by teachers teaching Biology concepts.

CHAPTER TWO
LITERATURE REVIEW

2.1 Biology Instruction in Secondary Schools

Biology is probably the most important of the science subjects studied at the secondary school level in the world. It belongs to the family of Science, Technology Engineering and Mathematics (STEM) significant for promoting socio- economic and technological advancement which for Kenya implies attainment of development target including vision 2030. One of the reasons for its importance is that it deals with living organisms and the environment that must be understood for a better life (Gloria, 2022). Mutisya, Itolondo and Ikinya (2021) observed that the subject deals with study of living things and how they interact with their environment and therefore its instruction involves preparing, presenting and evaluating learners on scientific concepts that deals with study of living things. Ong'amo, Ondigi and Omariba (2017) on their part maintain that Biology as a subject lays the foundations for entry into important careers like Human medicine, Teaching, Agriculture and Biotechnology. They also believe that it prepares the learners to deal with environmental problems like pollution, global warming, desertification and mushrooming of water weeds like hyacinth. The study of the subject is also believed to impart in learners' scientific knowledge and skills such as problem solving, critical thinking, data collection and analysis among others, which objectively prepares them for self-sustainability in the world economy (Shiundu & Omulando, 2012). Consequently, Biology instruction, due to its significance, demands that proper preparation and delivery be undertaken to enable leaners acquire requisite knowledge and skills critical for various sectors of the economy.

Biology instruction entails preparation, presenting and evaluation of learners on Biological concepts (Allchin Douglas, 2013). Traditionally, instructional process encompasses learners as recipients, teachers as instructors and a conducive learning environment which should have adequate and appropriate instructional materials or resources (Guskey, 2017). This means that the teacher, learner and instructional resources are significant components of an instructional process. While the learner is mainly perceived as the recipient, the teacher as a facilitator of the process, identifies, prepares, and presents Biological concepts. Instructional resources are the medium

through which the teacher gathers and presents the Biological concepts to enable learners better conceptualize them (McCourt, Andrews, Knight, Merrill, Nehm, Pelletreau & Lemons, 2017). Learning goals and objectives are a key part of instruction, informing curricular design, assessment, and learning. These goals and objectives are also applied at the programmatic level, with program learning outcomes (PLOs) providing insight into the skills that undergraduate Biology programs intend for their students to master (Clark & Hsu, 2023)

Preparation for Biology instruction entails sourcing for relevant content, methods and resources for teaching and learning. Suitable content may be obtained from various reference books that are appropriate to the level of the learners with the help of the schemes of work and the syllabus to avoid deviating from the norm (Murray, Pérez, Geist, & Hedrick, 2012). Comprehensive lesson notes are prepared at this stage together with a lesson plan to serve as guide. Appropriate instructional resources to support the lesson activities such as models, charts, posters, collage and cultural artefacts are obtained (Ashaver & Igyuve, 2013). Some of these resources are obtained within the school, sourced from the community while others may be made by students. However, improvisation from the environment is encouraged where the materials are unavailable (Tilling, 2021). Methods of presenting the lesson such as group discussion, demonstration, presentation and practical activities are chosen and the teacher may decide to vary them for better understanding of the lesson by the learners (Tesfaye & Berhanu, 2015). Selection of appropriate assessment methods that will provide feedback of the lesson are identified and may include a set of questions, some assignment or quizzes.

Lesson presentation forms the second step in the instructional process. It entails use of content, methods and resources previously prepared to inculcate in students' Biological knowledge, skills and aptitude as per the objectives of the lesson (Ntibi, Neji, and Agube, (2020). During lesson presentation the teacher continuously engages the learners in several ways including explaining concepts and posing questions as the lesson progresses to keep them in touch with the ongoing lesson. There is need to move progressively from previous known knowledge or concepts for continuity of the instructional process. It is also important to be innovative by varying the process as

well as improvising with community resources to spice the instructional process (Dalrymple, Bansal, Gaffar & Taylor ,2014). The teacher guides learners to manipulate teaching and learning materials and ensure they acquire maximum knowledge and skills from the materials. He/she facilitate formation of groups by learners in order to undertake learning activities like peer group discussion, manipulation of materials or sharing of materials where they are inadequate. The groups may be in accordance to gender in case of mixed schools or according to performance (Zhan, Fong, Mei, & Liang, 2015). During the period, a conducive environment is set for learners to seek clarification on difficult concepts. Learners are freely allowed to ask questions without victimization for better understanding. Chorus answers are discouraged and every question or answer from the learners may be considered valid and shall be moderated by the teacher to avoid discouraging weak learners.

In the course of lesson presentation, evaluation is carried out to obtain feedback which is important in making decision on the achievement of the set goals and objectives (Yang, Liu, & Liu (2019). Learners are given adequate activities for practice in order to internalize the concepts intended to be learnt. Assignments are also given for students to learn, practice and demonstrate level of achievement of the learning goals. This would provide information on where improvements or adjustments are required (Paolini, 2015). The teacher provides an opportunity for fieldwork or excursions for practical experiences. Fieldwork connects knowledge that the students gain in classroom with real world situation, allowing students to make new discoveries and understanding their environment from a totally new realistic angle (Fuller, 2012). When conducted outside the school, they provide real world learning or experiences and may enable students' access tools and environments that are not available in school. Instructional outcome is intended to express knowledge and skills student gain from teachers' instruction. According to López, Torrance, Rijlaarsdam, and Fidalgo (2017), these instructional outcomes anchor and guide the choices of instructional activities, materials, practice assignment and assessment task. Basically they help teachers guide their classroom activities and set students learning goals (Cherasaro, Reale, Haystead, & Marzano, 2015). Learning outcomes in form of assessment and alignment contribute to the transparency, quality, and progression of a program

(Worthington, Dewancker, & Dawson, (2017). The fundamental assumption from the outcome of Biology instructional process is that learners gain knowledge and skills intended by the teacher.

Cimer, (2012) carried out a study on what makes Biology learning difficult and effective with the aim of determining secondary school students' view. The study adopted a survey research design and was carried out with a mainly quantitative research approach but used qualitative methods as well. For these purposes, a self-administered questionnaire including three open-ended questions was employed to collect the data. It was administered to 207 11th grade students in the district of Rize, Turkey. The findings were that there are five topics that students had the most difficulties in learning; Matter cycles, endocrine system and hormones, aerobic respiration, cell division, and genes and chromosomes. The main reasons for learning difficulties were the nature of the topic, teachers' style of teaching, students' learning and studying habits, students' negative feelings and attitudes towards the topic and a lack of resources. To overcome these difficulties and make their Biology learning more effective, the participants suggested such strategies as teaching Biology through the use of visual materials, teaching through practical work, reducing the content of the Biology curriculum, using various study techniques, teaching Biology through connecting the topics with daily life and making Biology learning interesting.

Ali, Toriman and Gasim (2014) pointed out that the level of students' academic achievement in Biology subject was found to be very poor in Kano District in Nigeria. The scholars adopted a Survey design and simple random sampling was used in choosing the participants. Data was collected from 100 respondents who enrolled in form five from five selected secondary schools in Kano District. Data was collected by using questionnaire, documentary analysis of Senior Secondary Certificate of Education (SSCE) results for five years, observations and interviews. The finding revealed that factors responsible for poor academic achievement of students in Biology subject included; lack of qualified teachers, lack of attendance of the lesson by the teachers, lack of or insufficient library and laboratory facilities, inadequate computers in the schools, and over population of students per class. The students' learning problem in Biology subject can be improved by provision of qualified

teachers, use of computer assisted learning, and solving the above problems mentioned.

In Bungoma district in Kenya, Nyongesa (2015) carried out a study on Teachers Perspective on the Challenges in the Delivery of Content and Performance in Biology. The aim of the study was to investigate the influence of teacher related factors on performance of secondary school students in Biology. The Cross-sectional descriptive research design and the Ex post facto were employed in this study. Nine (9) secondary schools were randomly selected for study out of 139 schools in Bungoma district. Different categories of schools were used depending on the school set-up and these were (i) Single- gender boys' boarding schools (ii) Single- gender girls' boarding schools (iii) Single- gender girls' day schools (iv) Co-educational boarding schools (v) Co-educational day schools (vi) Co-educational boarding / day schools. A total of three hundred and sixty (360) form three students were randomly selected for the study. A student questionnaire (SQ) and a teacher questionnaire (TQ) were used as the main instruments of data collection. Class mark lists were used as tracking records of performance in Biology. Data collected was analyzed using descriptive statistics. The study established that boys perform better than girls in Biology. Female teachers were found to have a higher level of science anxiety in the teaching of Biology compared to the male teachers. It was established that most teachers still used the traditional lecture method in the teaching of Biology and only a smaller percentage were using the new approaches. This study was expected to significantly contribute in the provision of information that could be used by teachers, parents, educationists and policy makers to improve on the teaching, learning and performance of students in Biology, but the information was missing.

Although considerable progress has been made through the instructional process the results for KCSE (KNEC 2021) at national level and Meru South Sub County KCSE results in Table 1 and table 2 respectively in the last five years indicated a poor performance trend in Biology Subject. Table 1 indicates that Biology mean rating of students' performance in the subject ranged between 18.93% in 2017 to 27.02% in 2021 implying that a majority of KCSE graduates failed to enroll in a career that requires above average grade in Biology. It also implies that the country failed in

attaining its Millennium Development Goals (MDGs) of having a highly trained and skilled workforce in specific STEM related areas such as Biological sciences and related areas. Similarly, in Meru South Sub County the performance in Biology at KCSE level has been very poor, with an average mean grade of D with mean rating ranging from 2.62 in 2022 to 3.14 in 2021. The trend is not impressive to the schools, community and at national level as learners continue to be locked out of courses that require decent grades in Biology. Several factors were highlighted as the causes of poor performance, but nothing tangible was pinpointed in relation to instructional materials such as artefacts which can improve performance in Biology subjects which influenced the current study to find a lasting solution.

2.2 Cultural Artefacts and Biology Instruction in Secondary Education

Culture is people's way of life. Utum (2014) describes culture as the way people live in the midst of families and neighbours. According to the researcher, aspects of culture include; knowledge, beliefs, arts, moral, laws, customs and habits acquired by man as a member of a society. Artefacts are objects made by human-beings and the literal meaning of the word *arte-factus* in Latin is something made with skill that makes them different from natural objects which are not human-made. Such objects include; art, diaries, tools and clothing's made by people of any time and place (Barbor, 2021). Ching, Levin and Parisi (2014), refer to artefacts as objects from the material, educational, or artistic culture of the society. Similarly, Mizoguchi and Kitamura (2010) define artefacts as physical objects that can exist across time and space without a need for being used in a task. This observation is corroborated by Kozulin, (2020) who describes artefacts in a wide sense such that it includes the common use of the term as "materially objectified manmade things", but which also stands for all forms of humanly designed, socially objectified vehicles of functional meaning, material or not. Some scholars have used the term to imply a society or environment's materials, theories, and technological advancements that have their roots in the past and present cultural customs and practices. According to these scholars, such materials developed as a result of prevailing environmental acculturation, myth, and supernatural and mystical reality (Adonu, Nwagbo, Ugwuanyi, & Okeke, 2021). Such materials could be put to use in educational circumstance to help learners gain knowledge and skills by creating, reflecting and

discussing them with peer and mentors. On the other hand, Biology instruction entails preparation; presenting and evaluation of learners on Biological concepts as pointed out by Douglas (2013).

Artefacts which are historically produced may at times be considered modern due to technological advancement, but should still be intended to remind learners of past period of time in education. Sharma & Orey (2017) argue that cultural artefacts refer to the body of knowledge that is unique to a given group of people, including their languages, ideologies, practices, and cultures. Similarly, (Meisalo) refers to artefacts as man-made objects or materials for education or for artistic culture of a given community. Teaching and learning using locally accessible artefacts resources can help to foster meaningful retention, and give students first-hand or direct experience with the social and physical reality of their surroundings. Instructional artefacts can promote participation, especially if the pupils are given the freedom to handle the resources. Thus, it was imperative to establish the types of cultural artefacts used in Biology instruction in secondary schools in Meru South.

2.2.1 Types of Cultural Artefacts Used in Biology Instruction in Secondary Education

Biology instruction, just like other subjects require the use of a variety of resources for quality instructional outcome. Sharma and Orey (2017) in a study of application of cultural artefacts state that people generally remember; 10% of what they read, 20% of what they hear, 30% of what they see, 50% of what they hear and see ,70% of what they say and 90% of what they say as they do a thing. This is the reason instructional materials in teaching are paramount for they ensured more effective learning since leaners not only hears but also see and act. Learning being an active process should involve many different kinds of interconnected artefact resources. Nilsen and Gustafsson, (2016) advocate for instruction material acquired or locally produced with instructional content or function that can be used for formal or informal teaching and learning purposes. Cultural artefacts used in instruction of STEM subject such as Biology includes; bones, beads and beadwork, skins, temples and huts, jewelry among others are possible resources that can be used in teaching and learning process. Though, these artefacts have been used in certain topic of particular subjects, a replica

of the same can be applied in other fields. These cultural artefacts are used across the world with great success in making learning more realistic, practical and interesting.

Hocking, Holding and Schönlieb (2020) did a study of Australian Biology curriculums using artefacts. Their study used mixed research design; with a target population 121 school teachers with a sample size of 56 respondents. The study applied systematic sampling design. Learning using cultural artefacts made learners learns best when they are able to connect new learning with what they already know and can do. And they also learned best when they felt their culture and identity is valued and acknowledged. Although the study was done in a developed country, the findings would also be replicated in teaching and learning Biology subject in Meru South Sub County.

Taylor (2012) carried out a study of inquiry based approaches using artefacts in Biology teaching in United Kingdom. The study used descriptive research design, and the target population was 101 pupils in junior schools in North Agria with a sample size of 62 schools sampled using convenience sampling procedure. Learners were requested to make two-dimensional instructional artefacts for teaching Biology which included flat pictures, graphs, chart, and diagrams posters, comics using cartoons, slides, and films trips. The researcher observed that it was easy to make these artefacts and students were able to apply them when learning Biology subject for they made them with purpose. He further observed that it is of utmost importance to create a learning environment in which students can comprehend and enjoy learning Biology. Hence students become more interested when cultural artefacts were used. The applied materials for making the above learning artefacts are readily available in the study scope area to make Biology subject more interesting to learners in Meru South Sub County.

Dean and Hubbell (2012) did a study in France based on classroom instruction that works, which was research-based strategies for increasing student performances. The study used difference-in-difference estimation. The study used mixed methods of data collection. The collected data (qualitative and quantitative) were then tabulated, transcribed and analyzed using SPSS. Various customary artefacts such as resources including bones, beads and beadwork, sanctuaries items, huts, jewelry among others

were collected from France's former colonial states such as Mali, Madagascar and Benin that had a wide variety of concepts. The study found out that those cultural artefacts had varying shapes and elements which made learners appreciate the need of their cultural heritage while learning different subjects. As a result, they were of conclusion that learners do not have to depend on rote learning of cognitive concepts that are alien to them, but they can depend on locally produced instructional artefacts. Although the example of the above artefacts is from West and Southern Africa, some of these artefacts are available in Meru South Sub-County. However, such resources found can be replicated in teaching Biology Subject locally, an aspect that this study seeks to explore.

Pradhan Jaya (2021) undertook a study on the link between cultural artefacts and mathematics in relation to home and school environment in India, Tribhuvan Provence. The study applied constructivist theory and was a descriptive research design in nature. Students were encouraged to explore mathematical ideas through observation of different artefacts surrounding the temples. They were provided with measuring tape, paper, pencil, and other instruments by which they would explore and verify different mathematical properties. This required physical materials like measuring tapes, ropes, markers, etc. which were provided to the group. They sorted out the concepts of concentric circles, transformation, reflection, rotation, symmetry, pattern, and tessellations. The identification of concentric circles used to form such impressive artefacts also give hint on how these mathematical ideas were created at that time which was far from today's formal studies based on bookish knowledge. This approach provides students with the opportunity to learn mathematics in their own way and to develop mathematical ideas without the textbook and beyond the classroom. The above learning concept in mathematics can also be applied in teaching and learning of Biology.

Cooper (2021) did a study on ultraviolet detecting beads in Canada. The study was on electromagnetic spectrum which was perceived to have difficult concepts among the learners. The learners were requested to bring ultraviolet detecting beads in order to make bracelet. They wore them and watched how they changed colour. The beads changed color very quickly into pink, orange, yellow, blue and purple when exposed

to sunlight, on cloudy days the color changed slower and when not exposed to ultraviolet light the beads turned opaque white. They were fascinated to see white beads change color when taken outside the buildings and return back to white when back into the building. The question that disturbed their minds was the cause of the change; they thought it may have been humidity, temperature or fresh air.

According to Keith (2021), the teacher had to elaborate that beads contain pigments which react with ultraviolet light from the sun, even on a cloudy day. They also changed with most classroom UV light sources. Use of such beads can be replicated in the study of Biology for there is a great similarity in application of the same. Students can make their own UV light detecting bracelet by stringing the beads on a pipe stem or on a strip of rawhide to study various topics in Biology lessons. Lesson activities can be included for they can be interesting to learners. However, UV rays from the sun may cause skin cancer and is harmful to our eyes. Therefore, it is good to take precaution during the research.

On making artefacts, South African have a very colorful style of making geometrical walls with eye catching decoration mostly by the Ndebele women (Nhlangwini, 2018). On other hand Tonga women also are well known with constructing and decorated round huts using different shape in Zimbabwe (Sunzuma, Zezekwa, Zinyeka, & Chinyoka, 2013). The shapes of the Tonga and Ndebele houses have been motivating learners in calculations of the area and perimeters. As such if teachers and students can as well apply such cultural artefact in learning Biology subject, the general achievement in the subject would be enhanced. In similar observations, Brian and Hilda (2017) study in South Africa observed young boys making toy cars using copper wires. The scholars in the process documented that the shapes the young boys were making were additionally developed or observed from school learning. The finding from South Africa indicate that, if women and young boys can make exemplary structures, then teachers and students in secondary schools in Meru South Sub County can make more better artefacts which would be used learning Biology subject.

Affum (2019) did a study on impact of using beads from the Krobo community cultural artefacts in teaching and learning science subjects in Ghana. The method adopted qualitative research method. The descriptive method was used in describing the process of producing glass beads, their uses and symbolism in learning science subjects such as mathematics and Biology. The findings of the study pointed out that beads and other related artefacts were easy to make and they were available in the community which made the learners more interested in the subjects for their culture was gaining meaning in the learning process.

Melil (2018) in a study on the traditional use of leather as dress in Keiyo, Kenya, observed that preservation of leather allowed for insight into the attire of the ancient societies. The research applied a case study method which was qualitative in nature and used an interview guide and observation for data collection. The results were analysed using thematic analysis and classification approach. The study sought to analyze various types of skins used by Keiyo ethnic group of Kenya. Such skins were goat skin, ship skin and Columbus monkey. Goat skin performed a major role in the arena of dressing to make dresses (kesenet) for ladies which acted as a wrapper cloth for carrying babies. The study suggested that the skin were the earliest means of dressing among the Keiyo during the pre-colonial period. It further concluded that the skin had multiple utility among the Keiyo, such as dressing, beddings, baskets, shields, cloaks for ceremonial functions and aesthetic purposes. The study findings can help students of Biology in the study of evolution and to understand how the clothing's have evolved over time.

An analysis of the cottage industry among the Tharaka people of Tharaka south sub-county, Tharaka Nithi county, Kenya (1907-1963) indicated that Tharaka people were making a variety of indigenous items such as pots, mats, bee hives, boats, baskets, swords and hoes to sustain their livelihood (Muga, 2021). The coming of the European colonialists negatively affected these traditional cottage industries. The target population for this study was 75250 people but the study purposely sampled and interviewed 50 respondents. The study was carried out in Marimanti, Karocho, Chiakariga and Gituma location. Data collected was analyzed and interpreted qualitatively and quantitatively and employed descriptive research design. The study

found out that iron working, weaving; pottery, traditional beer production, flour and gruel production, wood-works, cloth making, snuff production, herbal medicine production and salt production were major cottage industries that existed in the area. The frequency to which such resources could be utilized to enrich the teaching and learning of Biology, remains largely unknown, an aspect that this study sought to explore.

Studies reviewed show that different types of cultural artefacts have been used in instruction of STEM subjects across the world. Majority of these studies have been conducted in Europe and Asian countries and a few in African countries with varying learning outcomes. Findings of such studies may or may not be directly applied to Kenyan educational situations. Additionally, most of the studies focused more on general instructional tools, without much emphasis on cultural artefacts which the current study aims at identifying. In most of the studies, beads and beardy were mostly searched artefacts in regard to the rich collection of artefacts which can be used in teaching and learning science subjects. They were also mainly used in Mathematics, and thus, there is a need to identify cultural artefacts which can be used in Biology as a stand-alone subject. This study therefore sought to establish types of cultural artefacts which are used in teaching and learning Biology in secondary schools in Meru South Sub County in an attempt to bridge the existing knowledge gap.

2.2.2 Frequency of Use of Cultural Artefacts in Biology Instruction in Secondary Education

In education, there are many ways to get learners engaged in learning and one way is use of cultural artefacts which can create an engagement in various levels of learning depending on the subject matter. Cultural artefacts can be used in any lesson activity to develop an idea or knowledge in a certain topic. They can also be used in making real life connections to a lesson topic or even in engaging students in a lively discussion or small group activity. To be able to achieve vision 2030, learners should be equipped with both cultural knowledge and even creativity skills. However, when teaching, to get learners motivated in learning science subject such as Biology it can be a difficult task as observed by Ali (2014). Cohen and Manion, (2014) observe that,

creating an environment that is engaging and motivating to learners can be done by the addition of cultural artefacts that provide a visual stimulant for the science learners. However, student perception mostly in Biology (Gloria, Cahyani & Yuliyani, (2022)), can be enhanced using authentic cultural artefacts although it is not a common practice. Nevertheless, using cultural artefacts to the learning process not only creates a learning environment that is conducive to the long term remembrance of the subject matter but also fulfill their requirements for more successful assessment results.

Caravita and Falchetti (2015) researched on bones at Civic Zoological Museum of Rome. The scholars pointed out that that the acquisition of the concept of life should be a priority in the study of Biology but, on the contrary, it is rarely the object of deliberate and informed teaching in our schools. The sample of 189 students aged 7 to 12 taking part in the programme and to a sample of over one hundred 17–18-year-old students visiting the Museum was used to come out with the finding. Not only did the younger students consider bones as non-living entities, so did a high percentage of lower and higher secondary school students, although many of them mentioned their "having cells" and acknowledged their growth. In a similar study by Tunnicliffe and Laterveer-de Beer, (2014), on an interactive exhibition about animal skeletons at the National natural history museum of Netherlands, pointed out that visitors were able to understand the skeleton and what to do with them after reading instruction manual. Hence, we can employ use of bones in our Biology secondary education.

Prokop, Prokop, Tunnicliffe and Diran (2017) in a study on Children's ideas of animals' internal structures used animal organs to enhance children's understanding of the skeletal and organ systems in Europe. Their study involved 702 participants' children aged 6–16 years (grade 1-9) on examining children to animals of various size, species and dimension (2D and 3D objects) and exploring factors which might affect the development of their knowledge where they were required to draw a 2D and 3D objects about species. The study finding was that using 2D representation of an animal negatively affected the content of children drawing and that of 3D representation had a positive effect.

They have been few studies on people's understanding of skeletons. A study that emerges in this area is by Andersson, Löfgren, and Tibell, (2020). Most of the work in this field that has been done has only involved children's understanding of human skeletons in England where the sample size was 175 students from six different age groups (ranging from 4 year olds to 20 year olds). In the study Students were presented, on separate occasions with specimens of a brown rat, a starling and a herring and asked to draw what they thought was inside each specimen, they were also asked to draw what they thought was inside themselves. The findings indicated that student understanding increased with age and the degree to which pupils know more about human than other skeletons.

Fakoyede and Otulaja (2020) conducted a study on the role of Beads and beadwork as cultural artefacts used in mediating learners' argentic constructs in science classrooms, a case for place-based learning in South Africa. The study was qualitative research approach incorporating a case study and interpretive approaches as framework and methodology. Field notes of what transpired in the classrooms were taken to enhance the validity of findings. The analysis involved frequencies of particular responses which were presented using tables and graphs. The 172 study participants were 72 students, 45 parents, 9 head teachers, 45 teachers, and 1 district, education officer. Pictures of models of carbon IV oxide (CO_2), water (H_2O), glucose ($C_6H_{12}O_6$) and fructose ($C_6H_{12}O_6$) structures were created by teachers and learners were taken of video as they did the models. With artefacts, learners seemed to have overcome impeding mental structures, the cognitive barriers and self-limitations, which had been hindering their expansion of their agency to critical emancipative learning. Further, learners seemed positively energized, and their agency in the class-room was expanded. The above artefacts are some of the instruments which have not been applied in teaching and learning Biology and can have a replica effects in our secondary schools.

Azzam Elsayed and Ramadan (2018) carried out research aimed at identifying the effectiveness of using the bone fish strategy in teaching the unit entitled "Transportation in living beings" to second grade secondary school students in developing depth of Biological knowledge and visual thinking skills. To achieve the

aim of the research, the unit, which was part of the Biology subject was redesigned and taught using the bone fish strategy. The sample consisted of sixty-four students, who were divided into two groups: one control (32 students) who studied through the conventional method and the other experimental (32 students) who studied using the bone fish strategy. Two instruments: the test of depth of Biological knowledge and the scale of visual thinking skills were used to collect data from the research groups before and after the treatment. Statistical analysis using means, standard deviations and t-test were carried out. The findings of the research revealed the effectiveness of using the bone fish strategy in developing Biological knowledge depth and visual thinking skills. The above strategy can be applied in teaching Biology classes in Meru South for these artefacts are accessible and readily available locally.

Baidoo (2021) did a study on the evaluation of jewelry subject in senior high school in Ghana to ascertain the career opportunity in jewelry for Ghanaian youth. The study adopted the mixed research approach with descriptive and document analysis as the research method used. The study pointed out that the motivating factor for introducing jewelry in learning science subject was good. However, very few teachers knew jewelry and majority were not professional jewelers. This limited practical jewelry application by teachers and students. A similar study by Naatu, (2016) on brand building for competitive advantage in the Ghanaian jewelry industry indicated that branding is a crucial component in marketing that determines the success of the organization. The study involved two entities, Precious Minerals Marketing Corporation (PMMC) and ERNIE'S Classic Jewelry. Data was collected from management and descriptive statistics was used to analyze the survey data. The results indicate that critical branding factors for competitive advantage adopted by the firms. However, Precious Minerals Marketing Company (PMMC) was found to be more competitive compared to ERNIE'S Classic Jewelry's through brand building. Although the study was based on marketing mix strategy, the same application can work in teaching Biology and it may be imperative to apply these skills in teaching Biology at secondary school in Meru South Sub county may help the need of students' performance improvement.

Kaahwa (2021), did a study on use of cultural artefacts in the teaching Mathematics in Africa and pointed out that the teaching is often by telling and this may lead to learner disliking the subject and even dodging lessons. He argued that, although mathematics is ingrained in culture and in the human mind, physical materials such as artefact can make learning easier. With artefacts in learning mathematics, Kaahwa concluded that any challenging topics can attract learners on what they had difficult in believing and make lessons more interesting to know. Thus, it would be important to establish the use of this method in Biology teaching in Meru South Sub County and of parts of Kenya.

Kabesa (2019) study was based on locally available resources as an instructional Aid in Secondary School Science in Kenya. The study was Descriptive-Survey design and the target population was 200 learners. The study established that many Locally Available Instructional Resources (LAIRs) can be used in teaching, beside textbooks. These resources if used would appeal to the different ways that students learn using different senses (visual, auditory, touch, smell and taste). LAIRs are all around us and can be used in the classroom, and that could support students' learning. Any school can generate its own learning resources at little or no cost. By sourcing these materials locally, connections are made between the science curriculum and students' lives. Using local experts and natural resources from the school's immediate environment who have expertise in a wide range of topics can help create links between students and the local community, demonstrate its value, stimulate students to see the richness and diversity of their environment, and perhaps most importantly work towards a holistic approach to student learning that is, learning inside and outside the school.

Reviews undertaken have shown that cultural artefacts have been used by instructors in teaching and learning of STEM subjects for quite some time. The studies have also indicated that teachers across the world have to a large extent used cultural artefacts to make instructional process more attractive and interesting in addition to encouraging active learning and development of different skills to the learner. However, use of cultural artefacts in teaching and learning has been found mostly in Asian countries and some in African countries with most of studies concentrating more in the field of Mathematics with limited tangible evidence on Biology subject. Hence this has

created the need for studies specific to instructional circumstances in the subject. The need is further created by lack of studies done in the Kenyan context exploring the extent of use of the resources even in the midst of existence of a variety of cultural artefacts among communities around educational institutions nationally and in Meru South Sub County. This study therefore sought to determine the frequency of use of cultural artefacts in Biology instruction with a specific focus on public secondary schools in Meru sub-county as a contribution to the ongoing debate.

2.2.3 Influence of Use of Cultural Artefacts on Biology Instruction in Secondary Education

Teaching and learning using instructional materials stimulates the total growth and development of learners in all perspectives. Instructional material influence learners to manipulate skills development, visual perceptive and perception toward a subject through exploration, feelings and social emotional needs. According to Hocking (2020), learning using artefacts resources can influence learners to build an understanding of their surrounding and physical objects. This is because most of the resources play an important role in understanding of concepts and imparting skills to the learner. Keith (2021) notes that use of cultural artefacts in sciences such as Biology is essential, for it promotes experiential learning. Uitto and Meisalo (2016) further argues that, learning using artefacts in Biology subject influences more than one of the human senses at the same time during learning process therefore, the use of artefacts as instructional resources is very vital to the secondary school students.

A study by Mallakpour, Behranvand and Mallakpour (2019) on experimenting with UV sensitive beads used 5 UV beads per participant, a ribbon, materials such as water, sunscreen, sunglasses, fabric and heavy paper or manila folders, glue and scissors for the experiments. The study was on electromagnetic radiation that was perceived as a difficult and abstract topic in a secondary school syllabus. The study of UV beads influenced the in-depth understanding of the topic. The beads changed colour very quickly into pink, orange, yellow, blue and purple when exposed to sunlight, on cloudy days the color changed slower and when not exposed to ultraviolet light the beads turned opaque white. The beads contained a special chemical that changed colour when exposed to UV light. Ultraviolet light is an

invisible type of light from the sun. It can burn our skin and cause cancer, damage our eyes and destroy our cells. Most UV is blocked by our Earth's ozone layer and atmosphere, but some still gets through and can be detected. The knowledge acquired can influence understanding of the effects of damaged ozone layer such as skin cancer and damage of our eyes in Biology subject.

Silah, Basaree, Isa, and Redzuan (2013) did a study on tradition and transformation, the structure of Malay woodcarving motifs in craft education. The scholars noted that Malay traditional woodcarving is one of the Malays' most intricate and amazing heritages, which acts as an identifier to their country. The study was based on collective information from historiography as the study design. The aim of this study was to study the structure of Terengganu Malay traditional woodcarving motif based on interpretations of Malay Aesthetic principles and elements is being applied to new motifs design to contemporary artwork, namely, painting and installation art. The study established that, the legacy of woodcarving is inheritance and is passed through many generations, therefore, it is only logical to preserve and uphold such traditions. The artist's statement is related to a master carver to create the new motif design with interpreting Malay aesthetic principles and elements in their work. The findings of this study to structure motif are vital in influencing understanding the intricate artworks of woodcarving motifs. It should be used as guidelines by those who are in related field such as science subjects to give meaning and depth of subject such as Biology. The topic of creating motifs and patterns according to culture, tradition and heritage should also be introduced in Biology subjects in secondary schools.

Capparotto, Bramuzzo, Callegaro, Poloni, Corrà, and Santovito (2017) study was based on using the didactics of Biology in primary school: an innovative approach to skeletal system teaching in fifth class based on comparative vertebrate anatomy in vertebrates in a Primary School of the province of Padua (Italy). The study applied the mixed method research which combined both qualitative and quantitative approaches. The analysis of the collected data was done using descriptive and inferential statistics. The study applied comparative vertebrate anatomy in vertebrates which is a traditional method (control group), based on a mnemonic learning and on a study from the school book, and a laboratory approach based on the scientific method

(experimental group). In the experimental group, the skeletal system was studied comparing some bones from different species of animal (chicken, duck, pig and cow). The manipulation and the direct observation of biological material allowed students to observe morphological similarities and differences in vertebrates, better understanding the structure of vertebrate skeleton. The obtained data confirms that the laboratory approach, if opportunely applied, allows having good results. Furthermore, the use of Comparative Anatomy allowed students of experimental group to better understand differences and similarities of the vertebrate skeletons. Today, teaching Biology in school is still mainly tied to the transmissive method based on behaviorist theories. As a consequence, the student is seen as a person who passively absorbs knowledge transmitted through textbooks. This makes the subject extremely tedious and tricky to students. Therefore, it becomes necessary for school to take on a new challenge: to stimulate children with passion, interest, curiosity about the world of science and to strengthen their critical approach to scientific issues. As claimed by authoritative proponents of teaching Biology, this will be possible through a change of methods and teaching practices in the didactic management. Teaching Sciences, and in particular Biology, must be characterized by active teaching in which students can learn by doing, actively involved in their learning and knowledge building.

Rotbain, Marbach-Ad, and Stavy (2016) study on the Effect of bead and illustration models on high school students' achievement in molecular genetics in Israel pointed out that student who applied the beads knowledge were good. The study involved 258 students who were grouped into; control group (116 students) that used traditional lecture format, while the others received instructions which integrated a bead model (71 students), or an illustration model (71 students). The study used three instruments: a multiple-choice and an open-ended written questionnaire, as well as personal interviews. The findings were that students who used one of the two types of models improved their knowledge in molecular genetics compared to the control group. However, the open-ended questions revealed that bead model activity was significantly more effective than illustration activity. On the basis of these findings, it is advisable to use a three-dimensional model, such as the bead model that engages students in activities with illustrations that can help improve their achievement in comparison to traditional instruction.

In an analysis of children's drawings of what they thought is inside their bodies, a study in South Africa indicated that children were able to draw individual organs but failed to show relationship between them (Dempster & Stears, 2014). The study involved seven-year-old South African children and sought to establish their knowledge of their internal anatomy. The study findings indicated that the informal knowledge children hold of what is inside their bodies appears to be acquired by informal means. The research was based on the ground that young children obtain most of their science knowledge through personal experience. The study recommended that introducing learners to well-structured skeleton could help them have a more complete knowledge on their internal organs as well as that of animals and enable them differentiate one from the other. Therefore, artefacts may be used to help learners develop understanding and acquisition of knowledge in the course of their growth and interaction with the natural world.

A study by Momanyi (2012), sought to investigate the application of Abagusii cultural practices in the teaching and learning of Mathematics in secondary schools in Masaba North Sub-County, Kenya. The study was based on constructivist theory by Jean Piaget and John Dewey. The study adopted a descriptive survey design. Data was collected using Mathematics Teachers' Questionnaire (MTQ) for teachers and Mathematics Students' Questionnaire (MSQ) for students. The target population included 86 teachers and 1741 form four students. Stratified random sampling was used to select six schools (19.35%) for the study. The study showed that Abagusi people have a special way of making baskets which show some mathematical concepts, estimation being more prominent. This was illustrated in estimation on how much reeds or grass was needed in each step in making baskets. The size of the basket was determined by what the container was to be used for implying that the amount of grass to be used for different sizes had to be estimated. More so the dancing styles of Abagusii were found to use constant sequence and patterns, advanced styles giving periodic sequences where dancers make different number of steps forward, backward and sideways indicating a mathematical concept. The study concluded that Abagusii culture has mathematical concepts that could be used in teaching and learning of Mathematics and teachers were encouraged to integrate such cultural practices into the Mathematics curriculum. The study recommended that curriculum developers and

teachers set up mathematical resource centers in every County to facilitate integration of cultural practices and artefacts in teaching Mathematics.

Mwiandi and Ombaka (2017) undertook an assessment of indigenous knowledge and practices on the use of clay among rural communities in Meru, Kenya. It involved a survey of clay applications such as the production of bricks, pots and other ceramic products which were amongst the range of indigenous arts and crafts the rural Meru people were engaged in since ancient time. An informal survey was conducted between September and December 2015 covering three administrative Sub locations in three sub counties (Kianjogu in Imenti South, Igane in Imenti Central and Kunati in Imenti North) of Meru County, Kenya. The study area was chosen because of the presence of clay deposits which were known to have historical use by local communities. The study adopted descriptive research design and a total of 174 structured questionnaires were administered to capture the primary data which included gender, age, education, household size, monthly income and their sources. Information on sources of information related to clay, organization membership and training, uses of clay, health effects and challenges encountered during clay applications were also sought. Findings were that traditional applications have taken roots and residents were ignorant of other advanced technological applications. The study established that there exists a variation in taste of food cooked from clay pots due to constituents' clay elements leaching into food from the pots. Findings imply that development and use of clay pots from the study area had health and educational implications significant to Biology instruction.

Empirical review undertaken on influence of use of cultural artefacts on Biology instruction indicates that, science subjects like Biology can be taught using cultural artefacts and students taught through such resources have been found to conceptualize concepts and perform better than their counterparts' who do not use them. Cultural artefacts have been found to have a profound influence on learners' transitive interest, motivation and knowledge in various subjects and the same can be replicated in Biology subject. The review showed that much of the studies of cultural artefacts in learning of STEM subjects have largely been undertaken in Asian countries as compared to other parts of the world leaving a gap in research for more local studies.

At the same time, studies done in Africa generally and especially Kenya on cultural artefacts have mainly focused on teaching and learning Mathematics thus implying a gap in research for studies specific to Biology instruction since instructional practices in Mathematics may or may not be directly applicable to Biology instruction. The study therefore was an attempt to contribute to the existing knowledge that seeks to establish the influence of cultural artefacts in Biology instruction.

2.2.4 Challenges of Using Cultural Artefacts in Biology Instruction in Secondary Education

Although the late 20th and early 21st centuries have witnessed a renewed interest in education due to internationalization, globalization, and the aftermath, inclusion of culture artefacts as instruction materials remains an unresolved issue and teachers have been confronted with many difficulties in teaching using cultural artefacts due to a number of reasons. They include negative attitude towards the resources, lack of effective instructional strategies in the use of the resources and minimal support for teaching using cultural artefacts. Another notable challenge is students who cannot truly master the use of artefacts until they master the cultural contexts in which the artefacts originated. That's why Silah, et al. (2013) observed that most teachers would ignore usage of cultural artefact available because they felt that learning is an abstract process that has completely nothing to do with semi-concrete materials like pictures, real objects and models.

Cimer, (2014) in a study on what makes Biology learning difficult and effective from students' point of views in Netherlands cited that classification of artefacts is a challenge to teachers. The study used mixed research design. The target population was 207 school teachers with a sample size of 177 respondents. The study applied systematic sampling design. The findings indicated that artefact classification constitutes seamless and acceptable answer to the continuum problems in teaching and learning Biology subject in the class. The recommendations were that classification of artefacts should be based on a clear methodological consideration. Artefacts objects which require to be classified as tools such as claw and hammers made from standardized materials can be easily recognized through their shapes,

colour and size. This field problem for artefacts is normally a version of well-known problem that's besets classification schemes in natural and social sciences globally.

An innovative teaching approach to circulatory and skeletal systems based on comparative vertebrate anatomy and physiology face challenges in teaching because teaching Biology in school is still mainly tied to the transmissive method based on behaviorist theories (Favaron, Ancona, Bramuzzo, Callegaro, Guidolin, Irato & Santovito, 2017). Though the student is seen as a person who passively absorbs knowledge transmitted through textbooks, to be learned by heart, It becomes necessary for schools to take on a new challenge that stimulate students with passion, interest, curiosity about the world of science and to strengthen their critical approach to scientific issues. This makes the subject extremely tedious and tricky to students. Tackling these challenges, it would be possible in changing of methods and teaching practices in the didactic management. The manipulation and the direct observation of Biological material (skeletal systems of vertebrates) allowed students to observe morphological similarities and differences in vertebrates, in order to understand the structure of those vertebrate body systems through real experience. The project included supplementary activities, differenced for the two systems, stimulating discussions and reflections about certain diseases of the skeletal system and exploring the circulatory system in a physiological perspective which was a challenge in its use.

Kaahwa (2021) did a study on use of cultural artefacts in the teaching of Mathematics in Uganda. He pointed out that teacher mindset had to be changed since teaching was often by telling and this may have led to learner disliking the subject and even dodging the lesson. The study involved a descriptive survey of the teachers' attitude towards mathematics. It then progressed to the training of the teachers on teaching mathematics using cultural artefacts as teaching aids. Workshops and interviews for community members were also held to find out how they viewed mathematics as well as their attitude towards mathematics and their children's education. The study revealed that teachers' mindset had to be worked on for them to make use of cultural artefacts as teaching aids. It was also established that the teaching and learning processes became easier and more interesting when teachers used cultural artefacts as

teaching aids. He argued that mathematics is ingrained in culture and in the human mind.

Hu, Li, Wang, Ai and Hu (2020), did a study about texture selection approach for cultural artefact, 3D reconstruction considering both geometry and radiation quality. The scholars discovered that 3D reconstruction of culture artefacts has great potential in digital heritage documentation and protection. They pointed out that Choosing the proper images for texture mapping from multi-view images is a major challenge for high precision and high quality 3D reconstruction of culture artefacts. The study proposed texture selection approach, considering both the geometry and radiation quality for 3D reconstruction of cultural artefacts while using multi-view dense matching. First, a Markov Random Field (MRF) method is presented to select images from the best angle of view among texture image sets which was a big challenge to student since they had no knowledge of how MRF method was used. Then, an image radiation quality evaluation model was proposed in the virtue of a multiscale, Tenengrad definition and brightness detection to eliminate fuzzy and overexposed textures. Finally, the selected textures were mapped to the 3D model under the mapping parameters of the multi-view dense matching and a semi-automatic texture mapping is executed on the 3DMax platform. Experimental results with typical cultural artefacts data sets (bronze wares, porcelain, skeleton and beads) shows that the proposed method can reduce abnormal exposure or fuzzy images to yield high quality 3D model of cultural artefacts. Although, the study was a success, student had difficulty in figuring out the use of MRF and Tenengrad application.

Aruan (2017), study on influence of culture and gender on secondary school students' level of scientific creativity in Biology education in Turkana County, Kenya and showed that the world and the global economy are changing very fast. Hence, we are faced with very significant economic, environmental and social challenges. Studies carried out in Kenya show that scientific creativity skills are very low amongst secondary school students. This means that there are factors that are hindering the acquisition of creativity skills among learners. Such factors include gender disparity and culture. The findings of this study show that there was a low level of scientific creativity in Biology education in Turkana County. Culture was also found to

influence the level of scientific creativity. The study also provided valuable information to policy makers, curriculum developers and implementers which could be helpful in fostering positive cultural practices by restructuring the curriculum to eliminate cultural blocks to scientific creativity among the students.

From various studies reviewed it has been shown that identification and availability of cultural artefacts is a big challenge which teachers face in instructional circumstances. Studies reviewed reveal that a majority of existing studies are either foreign based or do not specifically focus on challenges Biology teachers face while using cultural artefacts in Biology instruction. The current study therefore sought to provide data on the local challenges that Biology teachers faces when using cultural artefacts in Biology instruction in an attempt to contribute to the existing knowledge.

2.3 Theoretical Framework

Sekaran and Bougie (2019), describes theoretical framework as an important aspect in the research process for it provides strong evidence and explanation of previous proven theories and how they may apply to your new study. The study applied two theories; constructivist learning theory and sociocultural theory.

2.3.1 Constructivist Learning Theory

Constructivism learning theory states that people develop their own knowledge and understanding of the world, through the interaction of things and reflecting on experiences (Houkes & Vermaas, 2010). The constructivist theory is based on the idea that learners are active participants in their learning journey, while knowledge is constructed based on experiences (Ergazaki, 2016). As events occur, each person reflects on their experience and incorporates the new ideas with their prior knowledge. Learners develop *schemas* to organize acquired knowledge. This model was entrenched in learning theories by Vygotsky, Dewey, Piaget, Gagne, and Bruner. It further says that when learners experience something new, they harmonize it with their past experiences and ideas, which may lead to either changing what they believe or cast aside the new information as having no meaning (Miettinen & Virkkunen, 2015). Constructivism learning theory also states that, as each student moves through the learning journey, they get better at selecting and organizing information (Borgo,

Franssen, Garbacz, Kitamura, Mizoguchi, & Vermaas, 2014). They are able to better classify ideas and create more meaningful systems of thought. In this case, learners are active creators of their knowledge. Each student that enters a classroom has a unique perspective on life that has been created by their unique experiences and therefore this will impact their learning. If the basis of the constructivist theory states that students construct new knowledge on what they have already had, the entry point of their learning journey is of utmost importance. This theory was found applicable in explaining the dependent variable (Biology Instruction) which as a STEM learning area requires active participation of learners to construct their own knowledge for optimal learning outcome.

The constructivism theory was found relevant for the study on a dependent variable which is Biology instruction. As such, through constructivism theory cultural artefacts can be prepared by students through active participation which would instill the required knowledge as instructional tool in Biology. In a constructivism classroom, students often work in groups. This helps students to learn and support each other's in learning process valuing each other's opinion and input. Further through constructivism application, learners can prepare and identify artefacts through active participation which can influence knowledge acquisition in Biology lessons. And such reconstruction of cultural tools gives students opportunity for adequate experience on subject matter as instructional tools.

Since the theory states that people develop their own knowledge and understanding of things through the interaction of things and reflecting on experiences, constructivism gives students understanding and ownership of what they learn. Through constructivism, students are also assumed to accelerate learning based on students' explorations which is prerequisite in Biology lessons. Constructivist engages the students' initiatives and personal involvement in physical models, artistic representations which can be of any kind of objects in learning Biology subject. Engaging the creative instincts develops students' abilities to express knowledge through a variety of ways which is a requirement in Biology subject. The students are also more likely to retain and transfer the new knowledge to real life from applied objects making constructivism more applicable in Biology instruction.

2.3.2 Sociocultural Theory

Sociocultural theory of learning explains that learning occurs during social interactions between individuals and their environment. The proponent of Sociocultural theory of learning was Lev Vygotsky in 1923. The main desire of Vygotsky was to design a new way to look at and come up with a solution to educational and social problems of the time. He believed other factors, besides biological instincts, caused humans to act the way they do. He was the first modern psychologist to suggest a way in which culture plays a part in each person's nature. Vygotsky believed the inclusion of sign systems from a child's culture changes behavior and connects early and later forms of individual development. Thus, Sociocultural theory of learning one of the dominant theories of education today which posits that learning happens first through social interaction and second through individual internalization of social behaviors. In the sociocultural theory, students and teachers form relationships in the classroom to help the student learn. The relationships help facilitate social interaction and active participation in the learning tasks. Students learn through observation, listening and talking through their tasks. The theory assumes that human minds do not develop by virtue of some predetermined cognitive structures that unfold as one matures, but sociocultural theory informs that human mind develop through interaction with materials in the learning process where people learn from each other and use their experiences to successfully make sense of the materials they interact with. More so, sociocultural theory is valuable for the study because it focuses on the learners learning within their social, cultural, and historical context which is critical in learning, especially science subjects.

Vygotsky found that in order to understand a student's cognitive development, one must first understand their social, cultural, and historical background. Razzaq (2021) also argues that sociocultural theory "reflects the view that learning and development is not just a process of increased mental sophistication but is also mediated through social and cultural interactions. Cultural artefacts are materials that exist in the socio-cultural environment of the learner and these resources can help learners better acquire specific knowledge and skills in solving specific problems and, in the process become competent in a given topic in Biology. In reference to the sociocultural theory

relative to classroom instruction, cultural artefacts can be in form of picture, models or regalia with patterns for solving a problem. Most often however, such cultural artefacts are combinations of elements of different orders, and multi-level tool par excellence, combining culturally evolved arrangements of meanings. Learning by using such cultural tools helps the mind to develop and leads to new and more elaborate forms of mental functioning among students.

Sociocultural theory insists that cultural resources should allow for a synthesizing of teaching, learning, and cognitive development, thinking through the tools which are paramount in teaching and learning Biology concepts. Further, Sociocultural theory assumes that cultural artefacts as instructional materials have the capacity to develop in students the highest order of intellectual skills as they illustrate clearly, step by step how to follow which is a requirement in Biology subject concepts. According to Ramdani, Jufri, Gunawan, Fahrurrozi and Yustiqvar, (2021) instructional material can be used to develop higher learning abilities to the learners through self-teaching or guided learning. As students collaborate and engage with the material, the teacher becomes a coach and guides students along the process. Through both authentic activities and anchored instruction, learning takes place in a social setting, encouraging students to develop, share, and implement creative solutions to complex problems as collaborative teams. This theory was found applicable in explaining the independent variable (Cultural artefacts) which in STEM subjects which are important for practical engagement for better performance.

2.4 Conceptual Framework

The conceptual framework diagram shows the relationship between independent variable and dependent variables. The intervening variables have an effect on the dependent variable. In this study, the cultural artefacts are the independent variable, while Biology instruction is the dependent variable.

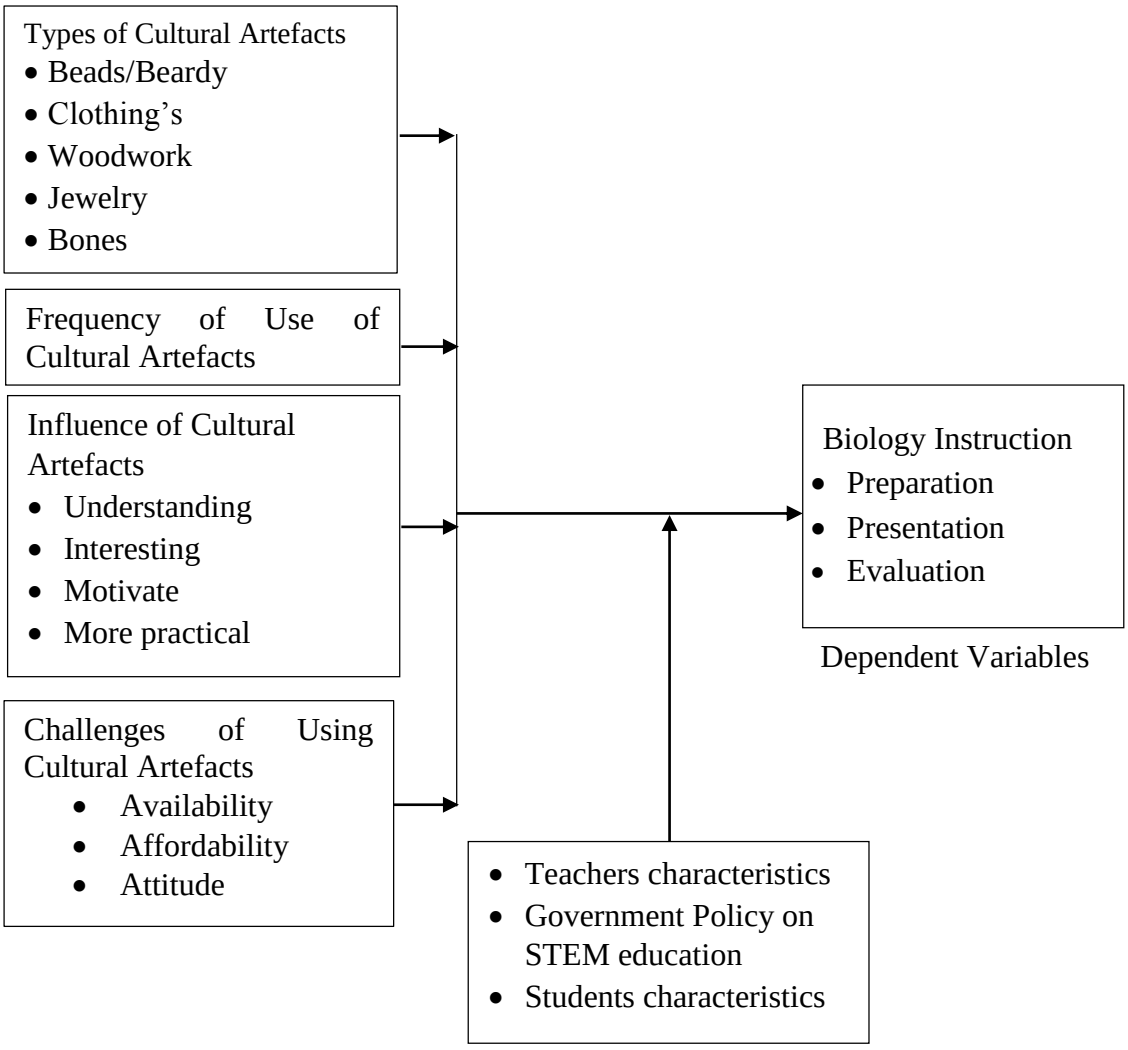

Figure 1: Conceptual Framework

The conceptual framework in Figure 1 depicts a diagrammatical representation of the relationship between variables of the study. In this study, the independent variable; types of cultural artefacts, frequency of use, and influence of use as well as challenges of using cultural artefacts contribute towards Biology instruction which entails preparation, presentation and evaluation as the dependent variable.

There are many types of cultural artifacts available and there those which can be made by teachers and learners. These artifacts are believed can assist in learning and teaching biology subject to enhance performance. More so, there are many kinds of cultural artifacts which are readily available in the communities and can also be used in teaching Biology subject. By identifying as many cultural artifacts or making them by the students can enhance leaning. The intervening variables have some effects on the dependent variable. The other variable is how frequently cultural artifacts can be used and how frequently teachers use them for teaching biology subject. Conceptually, Kroes and Meijers (2016) insist that teaching Biology requires elaborate and sometimes tangible objects which create a multi-faceted environment in order for an effective teaching. His notion can make the subject extremely tedious and tricky to students. Tackling these challenges, it would be possible in changing of methods and teaching practices in the didactic management. In this study, there many challenges which can affect the subject performance. First is teachers' characteristics, students' characteristics and government policy on STEM education though not measured in the study, may increase or decrease the magnitude of the relationship between the independent and the dependent variables. The effect of the intervening variable was reduced by using randomized sampling and effecting standardized procedures such as creating standard procedures to keep the environment the same for all participants.

Biology instruction in secondary school is influenced by cultural artefacts controlled by teachers characteristic, government policies and student characteristics. It is indicated that the types of cultural artefacts help in connecting new learning with what the student already know (Hocking, Holding & Schonlieb, 2020). Students understanding on cultural artefacts depended on the degree to which they are exposed the artefacts (Andersson, Lofgren & Tibell, 2020), leading to better internalization during Biology instruction. Use artefacts influences one or more of human senses Uitto and Meisalo (2016) during learning process.

The interviewing variables used in this study directly or indirectly impact on Biology instructions. Students' characteristics such as attitude's, background and their beliefs have a positive or negative influence on Biology instruction. Government policies

together with teachers' characteristics also affect Biology instruction. Teachers' attitudes, their commitment, motivation and instructional styles would therefore influence the extent to which the cultural artefacts are engaged in classroom practice. Teachers however work with the school which is dictated by government policy especially in STEM education. The school environment can inhibit or facilitate integration of cultural artefacts by classroom teacher. The school leadership plays an important role in facilitating the positive learning outcome using resources.

CHAPTER THREE
METHODOLOGY

3.1 Introduction

The methodology is absolutely needed in any research in order to find the accurate and effective research. This chapter presents the description of the research method used in the study. It includes research design and research method, study location, research instrument, population, sample size and sampling procedure, piloting, data collection procedures, data analysis and ethical considerations. To prevent that the research is going astray, a methodology is required, as Hasan (2004) said that the distribution of human curiosity to a problem with a particular treatment (such as checking, investigating, analyzing, and studied carefully and sincerely) in order to obtain something (such as reaching the truth answers to the problem, the development of science, and so on).

3.2 Research Design and Methods.

The research design is a unified, detailed and specific plan on how to acquire, analyze, and interpret data. According to Nazir (as cited by Nasution, 2004), research design is, All the processes required in the planning and execution of the study, from the preparation phase to the preparation stage of the report. The design of this research is descriptive quantitative and qualitative method because the data is presented in numerical and descriptive form. According to Sugiyono (2010) descriptive research is a study conducted to determine variables, either the variable is one or even more without making comparison or connect with other variables. Quantitative methods emphasize objective measurements and the statistical, mathematical, or numerical analysis of data collected through polls, questionnaires, and surveys, or by manipulating preexisting statistical data using computational techniques.

According to Sugiyono (2015) research method means the scientific way to get data with the purpose of certain usability data. According to Sugiyono (2015) Quantitative methods can be interpreted as research methods based on positivism philosophy, used to examine in a particular population or sample, data collection using research instruments, quantitative data analysis / statistics, with the aim to test the hypothesis set. By

employing descriptive survey research design, the study was to get the experiences, perceptions, feelings and thoughts of participants expressed in both qualitative and quantitative form as advised by Creswell (2017). Further, the rationale for applying the descriptive survey research design in the study was that both quantitative and qualitative approach was sufficient by themselves to capture the trends and details of the situation, such as a complex impact of artefacts on learner performance in Biology subject in secondary schools in relation to cultural artefact found in Meru South Sub-County. In addition, Kombo and Tromp (2006) agreed that a qualitative research approach allowed the phenomenon to be understood from the perspectives of the individuals who are affected, and in this case the teachers and secondary students in Meru South Sub-County.

3.3 Study Location

The study was carried out in Meru South Sub County in Tharaka Nithi County. Meru South Sub County boarders Mara Sub County, Tharaka Sub counties and Igambang'ombe Sub county making up the larger Tharaka Nithi County. It has four zones; Mwonge, Magumoni, Chuka and Karingani. Meru south sub county has 42 secondary schools, 38 public and 4 private schools.

3.4 Study Population

The target population for this study was form four Biology students, their Biology teachers and the heads of Biology subject in the study locale. Kasomo (2016) define a target population as people, events or records that contain the desired information and can answer the measurement questions. Amin (2015) goes further to note that target population is the specific population about which information is desired. The head of Biology subject and Biology teachers were the target population because they were in position to give reliable information on cultural artefacts in Biology teaching. Form 4 Biology students were targeted because they had a vast experience in Biology subject learning both in practical and theory. Meru South Sub County has 38 public secondary schools. Thus, the general target population was 38 Heads of Biology subject, 114 Biology teachers and approximate 4040 form four Biology students. Thus, the study population was 4192.

Table 3: Distribution of Target Population

Category	Target Population
Head of Biology Subject	38
Biology Teachers	114
Form four Biology students	4,040
Total Population	4,192

Source: Author (Daniel), (2023).

3.5 Sample Size and Sampling Procedure

The data source for this study was primary data which was collected within Meru south sub county. The data was corrected through the approval from Chuka University Ethics review committee and research permit form from National Commission for Science, Technology and Innovation (NACOSTI) and the County Commissioner and County Director of Education.

3.5.1 Sample Size

A sample is a sub group of the target population that the researcher plans to study in order to make generalization about the target population. Since we cannot study the entire population one needs to take a sample that is large and representative of the entire population. Taking a representative sample, reduced the costs incurred, the time taken to do the research and also the manpower needed to conduct the study.The representative depended on Sampling methodology, Sample size and Response rate. According to Kothari (2013) at least 30% of the target population is adequate to form the sample size and reccomends that when the target population is large over 1000 at least 10% sample size of that population is adequate in descriptive research, while for a small population less than 1000, a 20% is adequate to form a representative of the sample (Habib, Maryam & Pathik, 2014 & Kothari, 2014). The sample size for the study was 351 determined using the sample table developed by Krejcie and Morgan (1970) as shown in the appendix V

3.5.2 Sampling Procedure

The study adopted purposive, cluster and simple random sampling. First all schools in Meru south sub-county were clustered based on zones. Then, schools from where respondents were to be sampled were selected using simple random sampling based on the population quarter of the zone. At the school level, purposive sampling was

used to select the head of Biology subject to participate in the study. Form four Biology students were also purposively selected to take part in the study since they possessed specific characteristics desired in the study. In schools with more than one stream, one stream was selected using simple random sampling technique. In the stream selected, simple random sampling was used to sample 19 Biology students to take part in the study. Finally, the Biology teacher for the stream sampled was purposively sampled to take part in the study. In schools with more than one Biology teacher, simple random sampling was used to select another Biology teacher in the school to take part in the study.

Table 4: Sampling Matrix

Category	Target Population	Sampling Procedure	Sample size
Head of Biology subject	38	Purposive	16
Biology teachers	114	Simple Random/purposive	32
Form four students	4,040	Simple Random	303
Total	4,192		351

Source: Author (Daniel), 2023.

3.6 Research Instruments

Research instrument by Sugiyono (2015) is a measuring instrument such as tests, questionnaires, interview guides and observation guidelines used by researchers to collect data in a study. The research instruments applied in the study were questionnaire for students and Biology teachers and an interview schedule for heads of Biology subject. A questionnaire was used to gather information from students in form four and Biology teachers. An interview was conducted among heads of Biology subject. Adan & Orodho (2015) explains that questionnaires captured information on people's attitudes and opinions on issues. The questionnaires contained closed-ended questions. The questionnaire consisted of six sections; Section A on Bio-data, Section B on Biology instruction, section C information on types of cultural artefacts used, Section D information on frequency of use of cultural artefacts, Section E on information on influence of artefacts, section F covered the challenges on use of cultural artefacts. An interview schedule was used to collect information from the heads of Biology subject.

3.6.1 Questionnaire for Biology Teachers

A questionnaire was used to gather information from Biology teachers. The questionnaire was made up of six sections. Section I sought to gather information on respondent's background information, section II on Biology instructional process while section III contained information on the types of cultural artefacts. Other sections were section IV with information on the frequency of use of cultural artefacts, section V with information on influence of cultural artefacts and section VI on challenges teachers faced in using cultural artefacts. A copy of this instrument was attached to the proposal as appendix II. The study applied self-administered questionnaires for the teachers. The essence of using a questionnaire was pegged on directives by (Best & Khan, 2018) who maintains that questionnaires give respondents freedom to express their views or opinions, make suggestions and it is also anonymous therefore, the participants were able to produce more candid answers than is possible in an interview. Therefore, it was the most appropriate instrument for study because it sought to explore all the domains. In the study, the research questionnaire typically used close-ended questions.

3.6.2 Questionnaire for Biology Students

The study also used a questionnaire to solicit information from students on cultural artefacts as an instructional tool in Biology subject. The questionnaire also gathered information on the types of cultural artefacts, the frequency of use, influence of cultural artefacts in Biology and challenges in using cultural artefacts. The study used self-administered questionnaires to students as the consumers and beneficiaries of cultural artefacts in learning Biology. As advised by Kasomo (2016) a questionnaire gave respondent's freedom to express their views or opinions, make suggestions and it is also anonymous therefore, the participants were able to produce more candid answers than is possible in an interview. Therefore, it was the most appropriate instrument for the study because it sought to explore all of the domains. In the study, the research questionnaires were typically close-ended questions.

3.6.3 Interview Schedule for Head of Biology Department

The interview guide was used to gather information from head of Biology subject on cultural artefacts as instructional tool in Biology subject. The interview guide was

considered appropriate for data collection for the study because it enabled the researcher to collect detailed and first-hand information from the respondents. Through the guide, researcher noted downs the information from the non-structured questions. The interviewees were free to ask for clarification on the questions where appropriate to supplement information. The interview guide was administered to the head of Biology department. These interview guides are attached to Appendix VI.

3.7 Piloting

A pilot study was conducted to establish the validity and reliability of the research instruments. The pilot study was conducted among 71 respondents in 3 secondary schools in the neighboring Maara Sub County, which has the similar characteristics like those of Meru South Sub County. The study used simple random sampling to determine the schools from the list of schools in the sub county to eliminate biasness. The information collected from the pilot study assisted in identifying the weakness in terms of validity and reliability of the instruments with the help of an assigned supervisor.

3.7.1 Validity of the Instruments

To test the validity of the instruments, the questionnaire was availed to supervisors together with other panel of experts at Chuka University for review. The comments from the experts were incorporated in the final instrument revisions to improve its validity before data collection. According to Creswell and Creswell (2017), validity of an instrument is usually defined as the extent to which the instrument actually measures "what it is designed to measure" or "what it purports to measure," that is, it assesses the relevance of an instrument for addressing a study's purpose(s) and research question. Face, content and construct validity of the instrument was ascertained to ensure that the instruments met the required threshold through the help of the supervisors among other strategies. Face validity is the extent to which a test appears to measure what it claims to be measuring. To ensure face validity the questionnaire was presented to a panel of experts in the department of education. Content validity, is the extent to which the items in a test assess the same content or how well the content material is sampled in the test. Content validity was determined by supervisors together with other panel of experts at Chuka University. Construct

validity is the degree to which a test accurately measures what it intends to measure. Construct validity was examined using pilot studies to figure out what needed adjustment.

3.7.2 Reliability of Instruments

Reliability refers to consistency of scores that the same person would obtain if they were to take the test at other times or under different conditions from time to time, from form to form, from item to item, or from one rater to another (Adan & Orodho, 2015; Kothari, 2014; Best & Khan, 2018). Reliability increases transparency and decreases opportunities for biasness and hence certifying neutrality, and trustworthiness (Best & Khan, 2018). Cronbach's coefficient alpha was used to check the internal consistency in responses on a Likert scale and evaluate the reliability of the measures. According to Sekaran and Bougie (2019), said that reliability value which less than the number of 0.60 is considered poor, and the average of 0.70 can be accepted, whereas value which is more than 0.80 is considered good. An alpha level of 0.70 or above was acceptable (Cronbach, 1951). The coefficient alpha was an appropriate measure of variance "attributable to subjects and variance attributable to the interaction between subjects and items". Accordingly the coefficient alpha or Cronbach's alpha was used as a measure of internal reliability (Best & Khan, 2018).

3.8 Data Collection Procedures

Prior to data collection, the researcher obtained approval from Chuka University Ethics review committee and research permit form National Commission for Science, Technology and Innovation (NACOSTI). The researcher thereafter informed the County Commissioner and County Director of Education. Piloting was done to improve on the validity and reliability of the data collection instrument. The researcher further visited sampled schools and sought for permission from school authority to collect data and book appointment. The researcher also familiarized himself with schools from where data was to be collected. During the visit, the head teachers, heads of Biology subject and Biology teachers were informed of the purpose of the study and appointment dates were booked for actual data collection. During the data collection, the Biology teachers and form four Biology students were presented with questionnaires to fill with the assistance of the researcher. The researcher

conducted an interview from the head of Biology subject, notes were taken during interview and clarification was sought form HOS Biology.

3.9 Data Analysis

Data obtained was edited coded and analysed qualitatively and quantitatively based on study objectives. According to Kasomo (2016), data analysis is the procedure which includes the process of packaging the collected information, putting it in order and structuring its main components in a way that the findings are easily and effectively communicated. Qualitative data was analysed thematically. For quantitative data, descriptive and inferential statistics was applied with the aid of Statistical Package for Social Science (SPSS) version 26 computer software. Descriptive statistics including frequency and percentages was used to describe the existing relationship between the variables. Research hypothesis was tested at 95% level of confidence limits using logistic regression. The findings were presented using frequency tables and percentages.

Table 5: Data Analysis Matrix

Objective	Independent Variable	Dependent Variable	Methods of Data Analysis
To find out the types of cultural artefacts used in Biology instruction in Meru South Sub-County	Artefacts available	Biology Instruction	Frequencies and Percentages
To establish the frequency of use of various types of cultural artefacts in Biology instruction in Meru South Sub- County	Frequency of use	Biology Instruction	Frequencies and Percentages
To determine the influence of use of cultural artefacts on Biology instruction in Meru South Sub- County	Influence of use	Biology Instruction	Frequency and percentages Logistic Regression
To find out challenges teachers face in using cultural artefacts in Biology instruction in Meru South Sub-County.	Challenges of use	Biology Instruction	Frequencies and Percentages

3.10 Ethical Considerations

Ethical issues have been defined as branch of philosophy which deals with ones' conduct and serves as a guide to one's behavior (Orodho, 2015; Kothari, 2013). Before going to the field, the researcher obtained permission from relevant authorities to carry out the research. The researcher also sought to obtain informed concert from participants. The researcher assured them of confidentiality of the information obtained and promised them that the information obtained shall only be used for the purpose of study. Thus, caution was taken since the study was dealing with issues which touched on participant lives and profession in the processes of getting real data required from the participants. Before commencement of data collection, the participants were informed of the nature of the study and were to be performed with the informed consent of the participants. Statements of confidentiality of the information provided were to be written on the questionnaires and verbally communicated during questionnaire administration. During data analysis, the researcher acknowledges all the source of information and reference accordingly hence avoiding plagiarism and ensuring anonymity where need be.

CHAPTER FOUR
RESULTS AND DISCUSSIONS

4.1 General Information

This chapter presents a summary of data obtained from sampled respondents, its interpretations and discussion according to study objectives. The study sought to find the types, frequency and influence of use of cultural artefacts in Biology instruction in public secondary schools in Meru south sub-county. The study also sought to establish challenges teachers face in using those cultural artefacts in Biology instruction.

To achieve the study purpose, a descriptive survey research design was adopted. A total of 345 respondents including 302 form four Biology students, their 31 Biology teachers and 12 Heads of Biology subject participated in the study. Compared to the anticipated 351 respondents initially sampled, the study attained a 98.29% 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 6.

Table 6*:* Reliability Index

Variable	Teacher Questionnaire		Students' Questionnaire	
	Items	Cronbach' Alpha	Items	Cronbach' Alpha
Biology Instruction	12	0.822	8	0.774
Type of Cultural Artefacts	12	0.685	12	0.726
Frequency of Use	12	0.871	12	0.918
Influence of use	9	0.910	9	0.836
Challenge	7	0.928	-	-
Average	-	0.843	-	0.814

Findings on test for reliability of the variables that the Cronbach's Alpha for the variables ranged between 0.685 for types of cultural artefacts to 0.928 for challenges that teachers face in use of cultural artefacts in Biology instruction. For the students' questionnaire, the reliability index ranged between 0.726 for types of cultural artefacts and 0.918 for frequency of use of cultural artefacts. Findings mean that all the

variables had reliability index above the 0.7 required threshold and therefore were all adopted for further analysis.

4.2 Demographic Information

Demographic information was sought from sampled respondents who included form four Biology students, their Biology teachers and the Biology HOS. This section presents findings of each sequentially.

4.2.1 Students' Demographic Information

Information on form four students' gender and type of school was sought. Findings on each attribute were as summarized in Table 7.

Table 7*:* Biology Students' Demographic Information

Variable	Category	Frequency	Percentage
Gender	Male	111	36.8
	Female	191	63.2
	Total	302	100.0
Type of school	Mixed Day	96	31.8
	Mixed Boarding	150	49.7
	Girls only	56	18.5
	Total	302	100.0

Findings show that there were almost twice as many females (63.2%) Biology students compared to male students (36.8%) who participated in the study by returning useful questionnaires. This could be interpreted to mean that Biology is more preferred by the females students compared to males students. With regard to type of school, a majority of the students were drawn from mixed boarding schools (49.7%) compared to students from mixed day schools (31.8%) or Girls only schools (18.5%).

4.2.2 Biology Teachers' Demographic Information

Demographic information sought from Biology teachers included: gender, level of education, teaching experience and type of school. Findings were as presented in the Table 8.

Table 8: Biology Teachers' Demographic Information

Variable	Category	Frequency	Percentage
Gender	Male	19	61.3
	Female	12	38.7
	Total	31	100.0
Level of Education	Diploma	6	19.4
	Degree	24	77.4
	Masters	1	3.2
	Total	31	100.0
Teaching Experience in years	Less than 5	8	25.8
	5-15	19	61.3
	More than 15	4	12.9
	Total	31	100
Type of School	Mixed Day	6	19.4
	Mixed Boarding	20	64.5
	Girls only	5	16.1
	Total	31	100.0

Data obtained show that there were more male Biology teachers (61.3%) compared to female teachers (38.7%). Findings imply a fair distribution of Biology teachers based on gender with males being slightly more than females. Information on teachers' level of education show that more than three quarters of them (77.4%) were graduates with a bachelor degree while the remaining were either diploma certificate holders (19.4%) or had a master's degree (3.2%). Findings mean that all teachers sampled were trained teachers with the requisite educational qualification.

Findings on teaching experience show that about three quarters of the teachers (74.2%) had taught Biology for more than five years, a time considered as adequate for them to have acquired experience to provide required information relative to Biology instruction. Information on the type of the school from where the respondents were drawn show that a majority were from mixed boarding schools (64.5%) compared to those from mixed day (19.4%) and girls only schools (16.1%) similar to data obtained from Biology students.

4.3 Findings on Cultural Artefacts and Biology Instruction

The finding sought to establish the state of Biology instruction in public secondary schools in Meru South sub-county. Form four Biology students and their Biology teachers were provided with a set of statement to establish their views. Findings were

as presented in Table 9. Data obtained from Biology teachers showed that a significant proportion (96.8%) source for relevant content, a majority source for appropriate instructional resources (87.1%), identify appropriate methods of presentation (83.9%) and select appropriate assessment method (77.5%). Findings imply that more than three quarters of the Biology teachers (86.33%) confirmed adequately preparing for Biology instructional process. Kariuki et al. (2019) in a study meant to assess the influence of teacher preparedness on pupils' performance in Mathematics in lower primary schools in Aberdares region in Kenya established significant differences in pupils' performance in Mathematics based on teacher preparation for the lesson. The study thus recommended that the need for teachers to institutionalize as a best practice adequate preparation before commencement of teaching.

Table 9: Biology Instructional Process

Biology instructional process activities	Teachers (N=31)		Students (N=302)	
	NE/LE/ME	GE/VGE	NE/LE/ME	GE/VGE
Source for relevant content	3.2	96.8	-	-
Source for appropriate instructional resources	12.9	87.1	-	-
Identifying appropriate methods of presentation	16.1	83.9	-	-
Select appropriate assessment method	22.5	77.5	-	-
Continuously engage learners	3.2	96.8	29.1	69.9
Help learners manipulate learning materials	12.9	87.1	34.8	65.2
Facilitate learners to form groups to undertake activities	25.8	74.2	29.8	70.2
Give learners opportunity to ask questions to seek clarification	6.5	93.5	15.2	84.8
Give students adequate exercises for practice	9.7	90.3	27.5	72.5
Give assignments which are easy to respond to	29.0	71.0	42.7	57.3
Provide opportunity for adequate experiments and field work.	35.5	64.5	38.4	61.6
Provide prompt feedback for assignments and activities given	25.8	74.2	33.8	66.2

NE – No Extent, LE –Little Extent, ME –Moderate Extent, GE –Great Extent, VGE – Very Great Extent.

Findings on lesson presentation show that a significant proportion of teachers (96.8%) continuously engage learners during the process, help learners manipulate learning materials (87.1%), facilitate learners to form groups to undertake activities (74.2%) and give learners opportunity to ask questions to seek clarification (93.5%). This could be interpreted to mean that more than three quarters of teachers sampled (87.90%) indicated that they endeavour to facilitate an interactive and learner centered classroom instruction. This was confirmed by the Biology students, a majority who acknowledged that their teacher continuously engages them (69.9%), help them manipulate learning materials (65.2%), facilitate them to form groups to undertake activities (70.2%) and give them an opportunity to ask questions to seek clarification (84.8%). This means that findings from a majority of both Biology teachers and students concur that classroom presentation of Biology concepts is both interactive and learner centered which is critical for effective learning outcome. Munna and Kalam (2021) in their study entitled teaching and learning process to enhance teaching effectiveness observed that an active learning environment promotes inclusivity and improve the faculty and student academic performances.

Findings also illustrated that a majority of Biology teachers (90.3%) give students adequate exercises for practice, give assignments which are easy to respond to (71.0%), more than half provide opportunity for adequate experiments and field work (64.5%) and provide prompt feedback for assignments and activities given (74.2%). This means that a significant proportion of the sampled Biology teachers (75.0%) acknowledged adopting appropriate formative assessment procedures during Biology instructional process. Their observation was supported by the students, a majority who indicated that their Biology teacher gives adequate exercises for practice (72.5%), gives assignments which are easy to respond to (57.3%), provides opportunity for adequate experiments and field work (61.6%) and provide prompt feedback for assignments and activities given (66.2%). Li, Wang, Mayer, & Liu (2019), observed that in the course of lesson presentation, evaluation is carried out to obtain feedback which is important in making decisions on the achievement of the set goals and objectives. Similarly, Worthington (2017) observed that learning outcomes in form of assessment and alignment contribute to the transparency, quality, and progression of an instructional program. Munna and Kalam (2021) suggested that

providing positive and adequate formative and developmental feedback has a profound positive impact on the students' confidence and self-esteem. Qualitative data obtained from Biology HOS illustrated a general below average trend in students' performance in Biology in the sampled schools, the mean performance ranging between 1.89 (D-) and 3.60 (D+) out of 12 (A) between 2018 and 2022 in the Kenya Certificate of Secondary Education examination. According to the interviewees, the general poor performance could be attributed to among other reasons; *inadequate instructional resources, abstract concepts and limited qualified and experienced Biology teachers*. According to a majority of the interviewees, resource availability and use to *a great extent* contributed to the below average performance observed in Biology in their schools.

4.3.1 Types of Cultural Artefacts used in Biology Instruction

The study thus proceeded to assess the contribution of cultural artefacts on Biology instruction. The first objective sought to determine the types of cultural artefacts used in Biology instruction in Meru South Sub-County. Biology students and their teachers were provided by a set of types of cultural artefacts to select the ones they integrated in the course of Biology instructional process. Findings were as presented in Table 10.

Table 10: Types of Cultural Artefacts used in Biology Instruction

Resources with local "Chuka" names	Teacher		Students	
	Yes	No	Yes	No
Baskets & basketry (Ciondo)	3.2	96.8	2.3	97.7
Marts & waved materials (Mathithu)	0.0	100.0	4.6	95.4
Clay pots (Nyngu, Nthiri, Ngio)	6.5	93.5	7.6	92.4
Bows and Arrows	0.0	100.0	9.6	90.4
Beads & necklaces (Ciuma, mikathi, Nyenje)	45.2	54.8	11.3	88.7
Music Instruments (Mwinjiro, coro, ciigamba,Nguri, Kithithi etc)	3.2	96.8	6.6	93.4
Iron metal works (matumo, rangani,nthuku, ruoro, etc)	3.2	96.8	10.9	89.1
Skins (ndarua, ng'athi, masks)	35.5	64.5	13.2	86.8
Wood carvings (Miatu, Nkimi,Miburo, Muro etc)	45.2	54.8	12.9	87.1
Bones from skeletons of animals	87.1	12.9	71.9	28.1
Earth paints (Mwanyo, Iraa, muhu)	16.1	83.9	16.9	83.1
Stone work (Nthio, ithiga ria kuthia, kanoro)	12.9	87.1	19.2	80.8
Houses (mud huts)	9.7	90.3	14.6	85.4

Data obtained from Biology teachers indicate that bones from skeletons of animals (87.1%) is the cultural artefacts integrated by a majority of teachers in Biology instruction. Other moderately integrated cultural artefacts include Beads & necklaces (45.2%), wood carvings (45.2%) and skins (35.5%). Artefacts such as stones (12.9%), mud huts (9.7%), clay pots (6.5%), baskets & basketry (3.2%), music Instruments (3.2%) and iron metal works (3.2%) were integrated by fewer teachers in Biology instruction. Findings from Biology Students also identified bones from skeletons of animals (71.9%) as the most commonly integrated cultural artefacts. Findings thus confirm use of different cultural artefacts in Biology instruction in public secondary schools in Meru south sub-county. Nilsen and Gustafsson, (2016) advocated for instruction material acquired or locally produced with instructional content or function that can be used for formal or informal teaching and learning purposes. According to the researchers, cultural artefacts used in instruction of STEM subject such as Biology includes; bones, beads and beadwork, skins, temples and huts, jewellery among others are possible resources that can be used in teaching and learning process. Similarly, Keith (2021) in his study noted that Biology teachers used beads that contain pigments which react with ultraviolet light from the sun, even on a cloudy day to explain biological concepts. Such beads also change with most classroom UV light sources.

Qualitative data obtained from Biology HOS indicated Biology teachers' use of cultural artefacts in the teaching and learning of Biology in their schools. Interviewee A for instance indicated that their Biology teacher uses *bones and skin* in Biology instruction. This observation was supported by interviewee B, C, H and J. Interviewee D and E noted that other cultural artefacts integrated by their Biology teachers besides the bones and skins include *beads and teeth* (Nilsen and Gustafsson, 2016)

4.3.2 Frequency of Use of Various Types of Cultural Artefacts

The study also sought to establish the extent to which the cultural artefacts were integrated in Biology instruction. The second objective sought to establish the frequency of use of various types of cultural artefacts in Biology instruction in Meru South Sub- County. Data obtained on frequency of use from teachers and their students were as presented in Table 11 and 12.

Table 11: Frequency of Use of Cultural Artefacts (Biology Teachers)

Resources with local "Chuka" names	NA	Rarely	Sometimes	Often	Always	Total
Baskets & basketry (Ciondo)	87.1	6.5	3.2	3.2	-	100.0
Marts & waved materials (Mathithu)	83.9	12.9	-	3.2	-	100.0
Clay pots (Nyngu, Nthiri, Ngio)	83.9	9.7	-	6.5	-	100.0
Bows and Arrows	90.3	6.5	-	3.2	-	100.0
Beads & necklaces (Ciuma, mikathi, Nyenje)	35.5	22.6	29.0	12.9	-	100.0
Music Instruments (Mwinjiro, coro, ciigamba,Nguri, Kithithi etc)	90.4	3.2	3.2	3.2	-	100.0
Skins (ndarua, ng'athi, masks)	45.5	19.4	25.8	9.7	-	100.0
Wood carvings (Miatu, Nkimi,Miburo, Muro etc)	38.7	29.0	22.6	3.2	6.5	100.0
Bones from skeletons of animals	9.7	9.7	6.5	32.3	41.9	100.0
Earth paints (Mwanyo, Iraa, muhu)	83.9	6.5	3.2	3.2	3.2	100.0
Stone work (Nthio, ithiga ria kuthia, kanoro)	71.0	16.1	6.5	3.2	3.2	100.0
Houses (mud huts)	83.9	6.5	-	6.5	3.2	100.0

NA-Not At All

Data obtained from Biology teachers show that bones from skeletons of animals (74.2%) had the highest extent of use indicating that, teachers can access them during any time required which was followed by beads and necklaces (12.9%), skins (9.7%) and mud houses (9.7%). Baskets & basketry, Marts & waved materials, Clay pots, Bows and Arrows, Music Instruments, Earth paints, and Stone work are not widely used. The findings suggest that bones (41.9%) are readily available for use since it's always used by teachers in class as instructional material. Findings also on the highest extent of use of bones in Biology instruction was confirmed by the students who also indicated that bones from skeletons of animals (51.4%) had the highest extent of use as illustrated in Table 12.

Table 12: Frequency of Use of Cultural Artefacts (Biology Students)

Resources with local "Chuka" names	NA	Rarely	Sometimes	Often	Always	Total
Baskets & basketry (Ciondo)	80.8	9.6	3.0	3.3	3.3	100.0
Marts & waved materials (Mathithu)	83.8	5.0	5.0	4.0	2.2	100.0
Clay pots (Nyungu, Nthiri, Ngio)	79.1	6.6	5.3	4.6	4.3	100.0
Bows and Arrows	78.5	7.9	5.0	5.0	3.6	100.0
Beads & necklaces (Ciuma, mikathi, Nyenje)	74.2	7.6	8.9	5.0	4.3	100.0
Music Instruments (Mwinjiro, coro, ciigamba,Nguri, Kithithi etc)	80.5	7.0	5.0	5.3	2.2	100.0
Skins (ndarua, ng'athi, masks)	73.6	7.6	5.6	6.6	6.6	100.0
Wood carvings (Miatu, Nkimi,Miburo, Muro etc)	74.5	6.6	9.3	3.0	6.6	100.0
Bone from skeletons of animals	23.5	7.6	17.5	14.6	36.8	100.0
Earth paints (Mwanyo, Iraa, muhu)	65.2	12.3	9.9	6.6	6.0	100.0
Stone work (Nthio, ithiga ria kuthia, kanoro)	75.1	8.6	7.0	4.0	5.3	100.0
Houses (mad huts)	76.5	8.3	6.3	3.6	5.3	100.0

NA-Not at All

Data obtained from Biology students show that bones from skeletons of animals (51.4%) had the highest extent of use indicating that, teachers can access them during any time required which was followed by skins (13.2%). Baskets & basketry, Marts & waved materials, Clay pots, Bowes and Arrows and Music Instruments are not used often as instructional materials. Findings on the highest extent of use of bones in Biology instruction was confirmed by the students who also indicated that bones from skeletons of animal had the highest extent of use.

Azzam Elsayed and Ramadan (2018) carried out a research aimed at identifying the effectiveness of using the bone fish strategy in teaching the unit entitled "Transportation in living beings" to second grade secondary school students in developing depth of Biological knowledge and visual thinking skills. The findings of the research revealed the effectiveness of using the bone fish strategy in developing Biological knowledge depth and visual thinking skills. Qualitative data obtained from the Biology HOS through interview returned a mix of responses. Whereas according

to interviewee A, D, E and H the extent of use of the cultural artefacts in Biology instruction were to a less extent, interviewee B, F, I, K and L indicated that it was to a great extent. On their part, interviewee C, G and J insisted that;

> *Cultural artefacts were only being used when it was relevant and necessary*

4.3.3 Influence of Use of Cultural Artefacts on Biology Instruction

The study also sought to establish the influence of the use of cultural artefacts on Biology instruction. The third objective sought to determine the influence of use of cultural artefacts on Biology instruction in Meru South Sub- County. Data obtained on teachers and their students' perception on use of cultural artefacts was as presented in Table 13 and 14.

Table 13: Biology Teachers' Perception on Use of Cultural Artefacts

Statements	SD	D	UD	A	SA	Total
Use of cultural artefacts such as bones can help learners understand the topic support and movement	-	-	-	9.7	90.3	100.0
Lesson activities influences learners to have interest on learning Biology subject	-	-	3.2	19.4	77.4	100.0
Use of cultural artefacts in Biology makes learning interesting.	3.2	3.2	-	29.1	64.5	100.0
When cultural artefacts are used they motivate in learning Biology	3.2	-	-	35.5	61.3	100.0
Cultural artefacts makes learning Biology more practical	3.2	-	3.2	25.8	67.8	100.0
Learning using cultural artefacts develops a connection mentally between the tool than verbal representations	3.2	-	6.5	41.9	48.4	100.0
Use of cultural artefacts prepares learners to deal with real life problems better.	3.2	-	6.4	45.2	45.2	100.0
Cultural artefacts make learning real and permanent	3.2	-	3.2	45.2	48.4	100.0
Cultural artefacts make learning difficult concepts simple	3.2	-	3.2	35.5	58.1	100.0

SD- Strongly Disagree, D- Disagree, UD-Not Sure, A- Agree, SA-Strongly Agree.

Data obtained show that all the Biology teachers (100.0%) believed that use of cultural artefacts such as bones can help learners understand the topic support and movement, a significant proportion (96.8%) indicated that lesson activities influence learners to have interest on learning Biology subject and that use of cultural artefacts in Biology makes learning interesting (93.6%). Similarly, almost all the respondents

(96.8%) suggested that when cultural artefacts are used they motivate in learning Biology, slightly less than this proportion (93.6%) believed that cultural artefacts makes learning Biology more practical and that learning using cultural artefacts develops a connection mentally between the tool than verbal representations (90.3%). At the same time, a majority of the teachers (90.4%) believed that the use of cultural artefacts prepares learners to deal with real life problems better, a significant proportion (93.6%) indicated that cultural artefacts make learning real and permanent and that cultural artefacts make learning difficult concepts simple (93.6%). Findings imply that a majority of the Biology teachers (94.3%) have a positive conception of the use of cultural artefacts in Biology instruction. Table 14 presents finding from Biology students.

Table 14: Biology Students' Perception on Use of Cultural Artefacts

Statements	SD	D	UD	A	SA	Total
Use of cultural artefacts such as bones can help learners understand the topic of support and movement.	3.0	1.0	4.0	13.6	78.4	100.0
Lesson activities influences learners to have interest on learning Biology subject.	1.7	2.3	7.0	32.5	56.5	100.0
Use of cultural artefacts in Biology makes learning interesting	3.3	1.7	7.3	33.7	54.0	100.0
When cultural artefacts are used they motivate students in learning Biology.	4.0	2.0	12.6	28.2	53.2	100.0
Cultural artefacts makes learning Biology more practical	2.3	4.6	8.9	29.8	54.4	100.0
Learning using cultural artefact develops a connection mentally between the tool than verbal representations	2.6	2.0	18.2	29.8	47.4	100.0
Use of cultural artefacts prepares learners to deal with real life problems better.	3.6	3.3	15.6	27.8	49.7	100.0
Community resources which are familiar to learners make learning real and permanent.	4.6	3.3	13.9	27.2	51.0	100.0
Instructional materials make learning difficult concepts simple	4.7	3.3	10.3	25.9	55.8	100.0

SD- Strongly Disagree, D- Disagree, UD-Not Sure A- Agree, SA-Strongly Agree.

Findings from Biology students show that a majority (92.0%) believe that use of cultural artefacts such as bones can help learners understand the topic support and movement, a significant proportion (89.0%) indicated that lesson activities influences learners to have interest in learning the Biology subject and that use of cultural artefacts in Biology makes learning interesting (87.7%). Similarly, a significant

proportion of the students (81.4%) indicated that when cultural artefacts are used they motivate in learning Biology, slightly more than this proportion (84.2%) believed that cultural artefacts makes learning Biology more practical and that learning using cultural artefacts develops a connection mentally between the tools than verbal representations (77.2%). At the same time, a majority of the teachers (77.5%) believed that use of cultural artefacts prepares learners to deal with real life problems better, a significant proportion (78.2%) indicated that cultural artefacts make learning real and permanent and that cultural artefacts make learning difficult concepts simple (81.7%). Findings similarly imply that a majority of the Biology students (83.21%) have a positive conception of the use of cultural artefacts in Biology instruction. The study thus proceeded to establish the influence of use of cultural artefacts in Biology instruction based on logistic regression analysis. Table 15 and 16 presents a summary of the findings.

Table 15: Influence of Use of Cultural Artefacts on Biology Instruction (Model Summary)

Step	-2 Log likelihood	Cox & Snell R^2	Nagelkerke R^2	X^2	df	Sig.
1	38.928[a]	.179	.233	3.237	1	.072

a. Estimation terminated at iteration number 5 because parameter estimates changed by less than .001.

Independent variable in the model was Biology instruction. The model was significant $\mathbf{X^2}$ (1)=18.61, p<0.001 and the Hosmer and Lemeshow Test confirmed model fit, $\mathbf{X^2}$ (1)=3.237, p=0.072. Cox & Snell R square predicted a variance of 17.9% while Nagelkerke R square predicted 23.3% variation in Biology instruction explained by the model. The model with independent variable explained 86.7% of respondents' conception of Biology instruction due to cultural artefacts, an improvement from the initial 67.7% initially predicted. Table 16 presents information on variables in the equation.

Table 16: Influence of Use of Cultural Artefacts on Biology Instruction (Regression Coefficient)

	B	SE	Wald X^2	df	Sig.	Exp(B)
Cultural artefacts	2.336	.610	42.673	1	.000	8.435
Constant	-4.642	1.298	44.657	1	.000	.000

a. Variable(s) entered on step 1: Subject content.

Regression analysis illustrated that use of cultural artefacts positively and significantly predicted Biology instruction, Wald $\mathbf{X}^2$ (1)=42.673, p<0.001, Exp(B) = 8.435. Findings mean that the use of cultural artefacts positively and significantly influences Biology instruction. Rotbain, Marbach-Ad, and Stavy (2016) in study on the effect of bead and illustrations models on high school students' achievement in molecular genetics in Israel pointed out that student who applied the beads knowledge were good. The study which used three instruments: a multiple-choice and an open-ended written questionnaire, as well as personal interviews showed that students who used one of the two types of models improved their knowledge in molecular genetics compared to the control group. However, the open-ended questions revealed that bead model activity was significantly more effective than illustration activity. On the basis of these findings, it advocated for use of a three-dimensional model, such as the bead model that engages students in activities with illustrations that can help improve their achievement in comparison to traditional instruction. Similarly, a study by Mallakpour, Behranvand and Mallakpour (2019) on experimenting with UV sensitive beads used 5 UV beads per participant, a ribbon, materials such as water, sunscreen, sunglasses, fabric and heavy paper or manila folders, glue and scissors for the experiments. The study of UV beads influenced the in-depth understanding of the topic. The beads changed colour very quickly into pink, orange, yellow, blue and purple when exposed to sunlight, on cloudy days the color changed slower and when not exposed to ultraviolet light the beads turned opaque white. Key informant interview undertaken with the Biology HOS provided qualitative information illustrating significance of cultural artefacts in Biology instruction. According to interviewee E;

> *Use of cultural artefacts in Biology instruction enhances mastery of concept in the subject and helps in fostering understanding*.

This observation was supported by interviewee G and J. In corroborating this assertion, interviewee A and D and H indicated that cultural artefacts were critical in teaching concepts such as *support and movement* (bones), *homeostasis and excretion* (skin) and *gaseous exchange* (rib cage). On their part, interviewee B, C and K insisted that cultural artefacts are critical for;

Capturing and maintaining learners' interests, stimulating learners and to help foster their understanding of abstract concepts.

Findings imply use of cultural artefacts such as bones and skin help in teaching biological concepts and therefore contribute towards Biology instruction. Keith (2021) noted that use of cultural artefacts in sciences such as Biology is essential, for it promotes experiential learning. Uitto and Meisalo (2016) further intimated that, learning using artefacts in Biology subject influences more than one of the human senses at the same time during learning process therefore, the use of artefacts as instructional resources is very vital to the secondary school students.

4.3.4 Challenges Teachers Face in using Cultural Artefacts in Biology Instruction

The fourth objective sought to assess the challenges that Biology teachers encounter when integrating cultural artefacts during Biology instruction. The fourth objective sought to establish challenges teachers face in using cultural artefacts in Biology instruction in Meru South Sub-County. Table 17 presents a summary of the findings.

Table 17: Challenges Encountered in Integrating Cultural Artefacts

Statements	SD	D	UD	A	SA	Total
Availability of cultural artefacts can be a challenging for teaching Biology.	6.5	6.5	9.7	25.8	51.5	100.0
Affordability of procuring or accessing them from the community may be a challenge to teachers.	3.2	12.9	6.5	38.7	38.7	100.0
It is challenging to effectively interpret the cultural artefact in relation to given topic.	6.5	9.7	16.1	45.2	22.6	100.0
Learners and teachers attitude towards certain artefacts can be a challenge due to cultural beliefs.	-	6.5	9.7	38.6	45.2	100.0
Simplicity of applying cultural artefacts can also be a challenge to teachers.	6.5	6.5	19.2	45.2	22.6	100.0
Students may not master the cultural contexts in which the artefacts originated for application.	3.2	9.7	9.7	38.7	38.7	100.0
Teacher's negative mindset towards cultural artefacts as teaching aids can be a challenge.	6.5	3.2	16.1	41.9	32.3	100.0

SD- Strongly Disagree, D- Disagree, UD- Not Sure, A- Agree, SA- Strongly Agree

Data obtained show that more than three quarters of the teachers (77.3%) sampled indicated that availability of cultural artefacts can be a challenging for teaching Biology, a similar proportion (77.4%) believed that affordability of procuring or accessing them from the community may be a challenge to teachers and slightly less than this proportion (67.8%) indicated that it is challenging to effectively interpret the cultural artefact in relation to a given topic. At the same time, a significant majority of the teachers sampled (83.8%) acknowledged that learners and teachers attitude towards certain artefacts can be a challenge due to cultural believes, more than two thirds (67.8%) believed that simplicity of applying cultural artefacts can also be a challenge to teachers, more than three quarters (77.4%) suggested that students may not master the cultural contexts in which the artefacts originated for application and slightly less than this proportion (74.2%) indicated that teacher's negative mindset towards cultural artefacts as teaching aids can be a challenge. Findings imply that a majority of the teachers sampled (75.1%) believed that there are a number of challenges that inhibit integration of cultural artefacts in Biology instruction. Cimer, (2014) in a study on what makes Biology learning difficult and effective from students' point of views in Netherlands observed that classification of artefacts is a challenge to teachers. Kaahwa (2021), in a study on use of cultural artefacts in the teaching of Mathematics in Africa established that teachers' mind-set had to be worked on for them to make use of cultural artefacts as teaching aids. Key informant interview carried out with the Biology HOS confirmed existence of a number of challenges that impede use cultural artefacts in Biology instruction. Among the challenges identified by a majority of the interviewees include;

> *Inadequacy of cultural artefacts, negative cultural beliefs and myths associated with use of some artefacts and difficulties to relate some artefacts with biological concepts by some students.*

Aruan, and Susan (2017) in a study on influence of culture and gender on secondary school students' level of scientific creativity in Biology education in Turkana County, Kenya and showed that instructional process faces very significant economic, environmental and social challenges. Factors highlighted include gender disparity and culture. The study showed that there was a low level of scientific creativity in Biology education, culture being a significant contributor to the level of scientific creativity.

CHAPTER FIVE
SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Summary

The study sought to find the types, frequency and relationship between use of cultural artefacts and Biology instruction in public secondary schools in Meru south sub-county. It also sought to establish challenges teachers face in using cultural artefacts in Biology instruction. A descriptive survey research design was adopted to provide information required. The study population included 38 Heads of Biology subject, 114 Biology teachers and 4040 form four Biology students in the study area. Data was collected from 345 respondents who included 302 form four Biology students, their 31 Biology teachers and 12 Heads of Biology subject. Data obtained was analyzed quantitatively and qualitatively. Quantitative data was analyzed descriptively using frequency and percentages and inferentially using logistic regression based on the study objectives. Qualitative data obtained was analyzed thematically.

Data obtained relative to Biology instruction indicated a majority of Biology teachers adequately prepared for Biology instructional process. They sourced for relevant content, sourced for appropriate instructional resources, identified appropriate methods of presentation and selected appropriate assessment method. Similarly, a majority indicated their endeavour to facilitate an interactive and learner centered classroom instruction by continuously engaging learners during the process, helping learners manipulate learning materials, facilitating learners to form groups to undertake activities and giving learners' opportunity to ask questions to seek clarification. Further, a significant proportion of the teachers acknowledged adopting appropriate formative assessment procedures during Biology instructional process. They indicated giving students' adequate exercises for practice, giving assignments which are easy to respond to, providing opportunity for adequate experiments and field work and providing prompt feedback for assignments and activities given. Their observations of the activities undertaken to facilitate Biology instructional process was confirmed by a majority of their students. However, data obtained from Biology HOS indicated a generally below average trend in students' performance in the subject in the sampled schools despite adoption of appropriate instructional practice for the subject. Among the factors perceived as responsible for the general poor

performance were inadequate instructional resources, thus the relevance of use of cultural artefacts to facilitate Biology instruction.

Relative to types of cultural artefacts used in Biology instruction, findings confirmed use of different cultural artefacts in Biology instruction in public secondary schools in Meru south sub-county. Specifically, information obtained illustrated that bones from skeletons of animals are the cultural artefact integrated by a majority of teachers in Biology instruction. Others moderately integrated cultural artefacts include Beads and necklaces, wood carvings and skins. Artefacts such as stones, mud huts, clay pots, baskets and basketry, music instruments and iron metal works were integrated by fewer teachers in Biology instruction. This was confirmed by Biology Students who also identified bones from skeletons of animals are the most commonly integrated cultural artefacts. Qualitative data obtained from Biology HOS corroborated use of cultural artefacts such as bones and skins as well as beads and teeth in the teaching and learning of Biology in their schools.

Data on extent of use of cultural artefacts confirmed use of different artefacts at variable rates. Specifically, bones from skeletons of animals had the highest extent of use followed by beads and necklaces, skins and mud houses. This was confirmed by Biology students who also indicated that bones had the highest extent of use in Biology instruction. Qualitative data obtained from Biology HOS returned a mix of responses, some interviewees indicating that the extent of use of the artefacts was low, others insisting it was high while some suggesting that cultural artefacts were only being used when it was relevant and necessary.

Relative to types of cultural artefacts used in Biology instruction, descriptive findings illustrated a positive conception of the use of cultural artefacts in Biology instruction by a majority of Biology teachers. They believed that use of cultural artefacts such as bones can help learners understand the topic support and movement, use of cultural artefacts in Biology makes learning interesting, when cultural artefacts are used, they motivate learning Biology, cultural artefacts makes learning Biology more practical and learning using cultural artefacts helps students develop a connection mentally between the tool than verbal representations. Their observation was corroborated by

Biology students, a majority who indicated having a positive conception of the use of cultural artefacts in Biology instruction. An inferential analysis of the influence of use of cultural artefacts on Biology instruction was sought through logistic regression. Regression analysis illustrated that use of cultural artefacts positively and significantly predicts Biology instruction. Findings mean that use of cultural artefacts positively and significantly influences Biology instruction. Qualitative data obtained illustrated that use of cultural artefacts in Biology instruction enhances mastery of concept in the subject and helps in fostering understanding. They also stated that cultural artefacts such as bones were critical in teaching concepts such as support and movement, skin for homeostasis and excretion and rib cage for gaseous exchange. Use of such artefacts was critical for capturing and maintaining learners' interests, stimulating learners and to help foster their understanding of abstract concepts.

Information sought whether there exist any challenges in use of cultural artefacts illustrated that a majority of the teachers sampled believed that there are a number of challenges that inhibit integration of cultural artefacts in Biology instruction. They included availability of cultural artefacts, affordability of procuring or accessing the artefacts, effectively interpreting the cultural artefact in relation to a given topic and learners and teachers' attitude towards certain artefacts among others. Qualitative data obtained from Biology HOS confirmed existence of a number of challenges that impede use cultural artefacts in Biology instruction. Among the challenges identified include inadequacy of cultural artefacts, negative cultural beliefs and myths associated with use of some artefacts and difficulties to relate some artefacts with biological concepts by some students.

5.2 Conclusion

The study sought to find the types, frequency and influence of use of cultural artefacts in Biology instruction in public secondary schools in Meru south sub-county. The study also sought to establish challenges teachers face in using those cultural artefacts in Biology instruction. The study therefore makes the following conclusions. Based on the findings on the first objective which sought to determine the types of cultural artefacts used in Biology instruction, it is concluded that cultural artefacts such as bones, beads and necklaces, wood carvings and skins, stones, mud huts, clay pots,

baskets and basketry, music instruments and iron metal are some the cultural artefacts used in Biology instruction in Meru South sub-county.

Information obtained for the second objective showed that bones from skeletons of animals are some of the cultural artefacts commonly used to a high extent. It can therefore be concluded that bones are the cultural artefacts commonly used to a high extent in Biology instruction. The third objective sought to determine the influence of use of cultural artefacts on Biology instruction. Descriptive findings illustrated a positive conception of the use of cultural artefacts in Biology instruction by a majority of Biology teachers. Inferential analysis based on logistic regression illustrated that use of cultural artefacts positively and significantly predicts Biology instruction implying that use of cultural artefacts positively and significantly influences Biology instruction. It can therefore be concluded that use of cultural artefacts positively and significantly influences Biology instruction.

The fourth objective sought to establish challenges teachers face in using cultural artefacts in Biology instruction. Descriptive findings illustrated the existence of a number of challenges including availability of cultural artefacts, affordability of procuring or accessing the artefacts, effectively interpreting the cultural artefacts in relation to a given topic and learners and teachers' attitude towards certain artefacts challenges that continue inhibit integration of cultural artefacts in Biology instruction. Qualitative findings indicated inadequacy of cultural artefacts, negative cultural beliefs and myths associated with use of some artefacts and difficulties to relate some artefacts with biological concepts by some students as some of the challenges. It can therefore be concluded that there exist a number of factors that inhibit integration of cultural artefacts in Biology instruction.

5.3 Recommendations

The findings of this study indicated use of various cultural artefacts in varying frequencies with a positive and significant influence on Biology instruction. The study therefore makes the following recommendations:

i. Biology teachers should identify and use more types of cultural artefacts in Biology instruction.

ii. Biology teachers should enhance the integration of cultural artefacts such as beads and necklaces, wood carvings and skins, stones, mud huts, clay pots, baskets and basketry, music instruments and iron metal to facilitate better conception of the abstract concepts that are being imparted.
iii. Schools administration should facilitate sensitization of teachers and students on the positive learning outcomes of resources such as cultural artefacts in an attempt to maximize their use in the instructional process in the midst of scarce financial and instructional resources.
iv. Biology Teachers should strive to project a more positive attitude towards utilization of instructional resources such as cultural artefacts to facilitate their maximum use in the instructional process.

5.4 Suggestion for Further Studies

The study identified the following areas for possible further research studies;

i. The study was conducted in Meru south sub-county, Tharaka Nithi County, Kenya. Studies in other counties on the relationship between use of cultural artefacts and Biology instruction are thus suggested.
ii. This study mainly focused on the types, extent of use and influence of cultural artefacts on Biology instruction as well as the challenges of use of cultural artefacts. Further studies on the relationship of specific cultural artefacts and instruction of specific biological concepts are open for investigation.

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APPENDICES

Appendix I: Informed Consent Form

Dear Respondent,

RE: INFORMED CONSENT FORM

I am a student at Chuka University taking a Master's degree in Science Education. I intend to carry out a research as one of the requirements for the award of a degree in Masters of Education in Science Education. My research topic is; **Cultural Artefacts and Biology Instruction in Public Secondary Schools in Meru South Sub-County, Tharaka Nithi County, Kenya.**

This study has been approved by Chuka University Ethics Review Board and poses no danger to you. Information obtained from the study will be treated with utmost confidentiality and will only be used for the purpose of this study. Your identity will not be revealed in any way should you agree to participate in the study.

You are kindly requested to participate in the study but you are free to decline to participate or to withdraw at any point in the course of the study should you feel so. If you agree to participate, kindly sign the space provided. Thank you in advance.

Yours faithfully,

Daniel Murithi Geoffrey.

(Researcher)

Sign …….

Date ……..

Appendix II: Questionnaire for Teachers

Instructions

You are kindly requested to respond to the Questionnaire given. This study forms part of my master's degree at Chuka University. There are no wrong or right answers; I am only interested in your own opinion. The response you give will be treated confidentially. Thank you in advance for assisting me in my survey.

Section I: Background Information

Indicate your response by a tick (√) against the appropriate box at each question

1. What is your Gender? Male ( ) Female ( )
2. Which of the following grades indicate your highest professional training?
   Diploma ( ) Bachelor's Degree ( ) Master's Degree ( ) PhD ( )
   Others, please specify.....…….....
3. What is your teaching experience in years?
   Below 5 ( ) 5– 15 ( ) Above 15 ( )
4. What is the type of your school?
   Mixed Day ( ) Mixed Boarding ( ) Boys only ( ) Girls only ( )

Section II: Biology Instruction

Biology instruction entails preparation, presentation and evaluation. In a scale of 1 to 5, where 1= No extent, 2= Little extent, 3=Moderate extent; 4= Great extent, 5= Very great extent; indicate the extent to which undertake each of the following during Biology instructional process.

Biology instructional process activities	5	4	3	2	1
During preparation for Biology lesson, I:					
Source for relevant content					
Source for appropriate instructional resources					
Identifying appropriate methods of presentation					
Select appropriate assessment method					
During Biology lesson, I:					
Continuously engage learners					
Help learners manipulate learning materials					
Facilitate learners to form groups to undertake activities					
Give learners opportunity to ask questions to seek clarification					
In order to evaluate learning, I:					
Give students adequate exercises for practice					
Give assignments which are easy to respond to					
Provide opportunity for adequate experiments and field					

work.					
Provide prompt feedback for assignments and activities given					

Section III: Types of Cultural Artefacts

1. The following are some of resources with a cultural connotations found among communities in Kenya. Kindly using a tick (√) to indicate your use or lack of use for each in Biology instruction.

Resources with local "Chuka" names	Yes	No
Baskets & basketry (Ciondo)		
Marts & waved materials (Mathithu)		
Clay pots (Nyngu, Nthiri, Ngio)		
Bows and Arrows		
Beads & necklaces (Ciuma, mikathi, Nyenje)		
Music Instruments (Mwinjiro, coro, ciigamba,Nguri, Kithithi etc)		
Iron metal works (matumo, rangani,nthuku, ruoro, etc)		
Skins (ndarua, ng'athi, masks)		
Wood carvings (Miatu, Nkimi,Miburo, Muro etc)		
Bones from skeletons of animals		
Earth paints (Mwanyo, Iraa, muhu)		
Stone work (Nthio, ithiga ria kuthia, kanoro)		
Houses (mad huts)		

Section IV: Frequency of Use of Cultural Artefacts

1. In a scale of 1 to 5 where 1= No at all, 2= Rarely, 3=Sometimes; 4= Often, 5= Always; indicate your frequency of use of each of the following resources in Biology instruction.

Resources with local "Chuka" names	5	4	3	2	1
Baskets & basketry (Ciondo)					
Marts & waved materials (Mathithu)					
Clay pots (Nyngu, Nthiri, Ngio)					
Bows and Arrows					
Beads & necklaces (Ciuma, mikathi, Nyenje)					
Music Instruments (Mwinjiro, coro, ciigamba,Nguri, Kithithi etc)					
Skins (ndarua, ng'athi, masks)					
Wood carvings (Miatu, Nkimi,Miburo, Muro etc)					
Bones from skeletons of animals					
Earth paints (Mwanyo, Iraa, muhu)					
Stone work (Nthio, ithiga ria kuthia, kanoro)					
Houses (mad huts)					

Section V: Influence of Use of Cultural Artefacts in Biology Instruction

1. In a scale of 1 to 5 where 1=Strongly disagree; 2=Disagree; 3=Not sure; 4=Agree and 5=Strongly agree; indicate your level of agreement with each of the following statements on use of cultural artefacts in Biology instruction.

Statements	5	4	3	2	1
Beads and necklaces are used in teaching genetics in Biology subject					
Beads colors have been used in teaching elements of blood composition in Biology subject					
Skins and skin fur has been used in teaching the functions of skin in Biology subjects					
Pots and guards may be used to demonstrate fermentation in anaerobic respiration.					
Stone of various shapes are used to show cells, cells types and functions					
Fish bone has been used in teaching of evolution in Biology subject.					
Artefacts such as bones are used on teaching skeletal system from different species of animal (chicken, duck, pig and cow).					
Bones artefacts of animals such as goats, cows and rabbits are used in teaching animal skeleton					

2. In a scale of 1 to 5 where 1=Strongly disagree; 2=Disagree; 3=Not sure; 4=Agree and 5=Strongly agree; indicate your level of agreement with each of the following statements on use of cultural artefacts in Biology instruction.

Statements	5	4	3	2	1
Use of cultural artefacts such as bones can help learners understand the topic support and movement					
Lesson activities influences learners to have interest on learning Biology subject					
Use of cultural artefacts in Biology makes learning interesting.					
When cultural artefacts are used they motivate in learning Biology					
Cultural artefacts makes learning Biology more practical					
Learning using cultural artefacts develops a connection mentally between the tool than verbal representations					
Use of cultural artefacts prepares learners to deal with real life problems better.					
Instructional materials make learning real and permanent					
Instructional materials make learning difficult concepts simple					

Section VI: Challenges Teachers Face in Using Cultural Artefacts in Biology Instruction

1. In a scale of 1 to 5 where 1=Strongly disagree; 2=Disagree; 3=Not sure; 4=Agree and 5=Strongly agree; indicate your level of agreement with each of the following statements on use of cultural artefacts in Biology instruction.

Statements	5	4	3	2	1
Availability of cultural artefacts can be a challenging for teaching Biology.					
Affordability of procuring or accessing them from the community may be a challenge to teachers.					
It is challenging to effectively interpret the cultural artefact in relation to given topic.					
Learners and teachers attitude towards certain artefacts can be a challenge due to cultural believes.					
Simplicity of applying cultural artefacts can also be a challenge to teachers.					
Students may not master the cultural contexts in which the artefacts originated for application.					
Teacher's negative mindset towards cultural artefacts as teaching aids can be a challenge.					

Thank you for participating in the study

Appendix III: Students' Questionnaire

Instructions

You are kindly requested to respond to the Questionnaire given. There are no wrong or right answers. I am only interested in your own opinion. The response you give will be treated confidentially. Thank you in advance for assisting me in my survey

Section I: Background Information

Indicate your response by a tick (√) against the appropriate box at each question

1. What is your Gender? Male ( ) Female ( )
2. State the type of your school? Mixed Day school ( ) Mixed Boarding ( ) Boys only ( ) Girls only ( )

Section II: Biology Instruction

In a scale of 1 to 5, where 1= No extent, 2= little extent, 3=Moderate extent, 4= Great extent, 5= Very great extent; indicate the extent to which your teacher undertakes each of the following during Biology instructional process.

Biology instructional process activities	**5**	**4**	**3**	**2**	**1**
During Biology lesson, the Biology teacher:					
Continuously engage us					
Allow us manipulate learning materials					
Facilitate us to form groups to undertake activities					
Gives opportunity to ask questions to seek clarification					
Give us adequate exercises for practice					
Gives assignments which are easy to respond to					
There are opportunity for adequate experiments and field work					
Provide prompt feedback for assignments and activities given					

Section III: Types of Cultural Artefacts

Kindly indicate using a tick (√) whether your teachers uses or does not use each of the following in Biology instruction.

Resources with local "Chuka" names	**Yes**	**No**
Baskets & basketry (Ciondo)		
Marts & waved materials (Mathithu)		
Clay pots (Nyungu, Nthiri, Ngio)		
Bows and Arrows		
Beads & necklaces (Ciuma, mikathi, Nyenje)		
Music Instruments (Mwinjiro, coro, ciigamba,Nguri, Kithithi etc)		
Skins (ndarua, ng'athi, masks)		
Wood carvings (Miatu, Nkimi,Miburo, Muro etc)		
Bone from skeletons of animals		
Earth paints (Mwanyo, Iraa, muhu)		
Stone work (Nthio, ithiga ria kuthia, kanoro)		
Houses (mad huts)		

Section IV: Frequency of Use of Types of Cultural Artefacts

3. In a scale of 1 to 5 where 1= No at all, 2= Rarely, 3=Sometimes; 4= Often, 5= Always; indicate the frequency your Biology teachers use each of the following resources in Biology instruction.

Resources with local "Chuka" names	5	4	3	2	1
Baskets & basketry (Ciondo)					
Marts & waved materials (Mathithu)					
Clay pots (Nyungu, Nthiri, Ngio)					
Bowes and Arrows					
Beads & necklaces (Ciuma, mikathi, Nyenje)					
Music Instruments (Mwinjiro, coro, ciigamba,Nguri, Kithithi etc)					
Skins (ndarua, ng'athi, masks)					
Wood carvings (Miatu, Nkimi,Miburo, Muro etc)					
Bone from skeletons of animals					
Earth paints (Mwanyo, Iraa, muhu)					
Stone work (Nthio, ithiga ria kuthia, kanoro)					
Houses (mad huts)					

Section V: Influence of Use of Cultural Artefacts in Biology Instruction

In a scale of 1 to 5 where 1=Strongly disagree; 2=Disagree; 3=Not sure; 4=Agree and 5=Strongly agree; indicate your level of agreement with each of the following statements on use of cultural artefacts in Biology instruction.

Statements	5	4	3	2	1
Use of cultural artefacts such as bones can help learners understand the topic of support and movement.					
Lesson activities influences learners to have interest on learning Biology subject.					
Use of cultural artefacts in Biology makes learning interesting					
When cultural artefacts are used they motivate students in learning Biology.					
Cultural artefacts makes learning Biology more practical					
Learning using cultural artefact develops a connection mentally between the tool than verbal representations					
Use of cultural artefacts prepares learners to deal with real life problems better.					
Community resources which are familiar to learners make learning real and permanent.					
Instructional materials make learning faster					

Appendix IV: Interview Schedule

Instructions

The interview schedule seeks your views on use of cultural artefacts in Biology instruction. There are no wrong or right answers; I am only interested in your own opinion. The response you give will be treated confidentially. Thank you in advance for assisting me in my survey.

1. How is the trend of Biology performance in your school? (Probe for factors limiting better performance)

2. To what extent does resource availability and use contribute to the level of performance in 1 above?

3. Do Biology teachers use cultural artefacts in teaching the subject?

4. If they do, what kind of cultural artefacts do they use?

5. What is the frequency of use in Biology instruction by the teachers?

6. What is the influence of cultural artefacts used in Biology instruction?

7. What are the challenges encountered while using these cultural artefacts by Biology teachers?

Thank you

Appendix V: Sample Size Determining Table

Table for Determining the Needed Size of a Randomly Chosen Sample from a Given Finite Population

Population	Sample	Population	Sample	Population	Sample
10	10	220	140	1200	291
15	14	230	144	1300	297
20	19	240	148	1400	302
25	24	250	152	1500	306
30	28	260	155	1600	310
35	32	270	159	1700	313
40	36	280	162	1800	317
45	40	290	165	1900	320
50	44	300	169	2000	322
55	48	320	175	2200	327
60	52	340	181	2400	331
65	56	360	186	2600	335
70	59	380	191	2800	338
75	63	400	196	3000	341
80	66	420	201	3500	346
85	70	440	205	4000	351
90	73	460	210	4500	354
95	76	480	214	5000	357
100	80	500	217	6000	361
110	86	550	226	7000	364
120	92	600	234	8000	367
130	97	650	242	9000	368
140	103	700	248	10 000	370
150	108	750	254	15 000	375
160	113	800	260	20 000	377
170	118	850	265	30 000	379
180	123	900	269	40 000	380
190	127	950	274	50 000	381
200	132	1000	278	75 000	382
210	136	1100	285	1 000 000	384

Source: Krejcie & Morgan (1970).

Appendix VI: Institutional Introductory Letter

CHUKA UNIVERSITY

Knowledge is Wealth *(Sapientia divitia est)* Akili ni Mali

OFFICE OF THE DIRECTOR
BOARD OF POSTGRADUATE STUDIES

Telephones: 020-2310512/18
Direct Line: 020-268 7625
postgraduate@chuka.ac.ke
P. O. Box 109-60400, Chuka
Website: www.chuka.ac.ke

REF: EM13/22602/19

22nd May, 2023

Director
National Commission for Science Technology and Innovation
Off Waiyaki Way, Upper Kabete
P O Box 30623, 00100
Nairobi.

Dear Sir / Madam,

Daniel Murithi Geoffrey

The above-named person is a *bona fide* student of Chuka University pursuing Master of Education in Science Education proposal titled: **Cultural Artifacts and Biology Instruction in Public Secondary Schools in Meru South Sub- County, Tharaka Nithi County, Kenya**

Mr. Murithi has defended at the Faculty level and is now expected to conduct research.
Any assistance accorded will be highly appreciated

Yours sincerely,

22 MAY 2023

Prof. Moses Muraya, Ph.D.

DIRECTOR
BOARD OF POSTGRADUATE STUDIES

Appendix VII: Ethics Review Letter

CHUKA UNIVERSITY

Knowledge is Wealth *(Sapientia divitia est)* Akili ni Mali

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**

16th May, 2023

REF: CUIERC/ NACOSTI/382
TO: **Daniel Murithi Geoffrey**

RE: Cultural Artifacts and Biology Instruction in Public Secondary Schools in Meru South Sub-County, Tharaka Nithi 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 16th May, 2023 – 16th May, 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) License

REPUBLIC OF KENYA

NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Ref No: **440234**

Date of Issue: **31/May/2023**

RESEARCH LICENSE

This is to Certify that Mr.. DANIEL MURITHI GEOFFREY of Chuka University, has been licensed to conduct research as per the provision of the Science, Technology and Innovation Act, 2013 (Rev.2014) in Tharaka-Nithi on the topic: CULTURAL ARTIFACTS AND BIOLOGY INSTRUCTION IN PUBLIC SECONDARY SCHOOLS IN MERU SOUTH SUB-COUNTY, THARAKA- NITHI COUNTY, KENYA for the period ending : 31/May/2024.

License No: **NACOSTI/P/23/26397**

440234

Applicant Identification Number

Director General
NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Verification QR Code

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See overleaf for conditions