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School-Based Conservation Club Strength and Learner Conservation Understanding and Engagement in Kenyan Primary Schools

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Research Article

Keywords: conservation education, conservation club strength, learner conservation understanding and engagement (LCUE), school-based conservation clubs, environmental literacy, Kenya

Posted Date: November 24th, 2026

DOI: https://doi.org/10.21203/rs.3.rs-11815157/v1

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Additional Declarations: No competing interests reported.

Abstract

School-based conservation clubs are widely used to promote environmental learning, yet limited evidence exists on how variations in club strength influence conservation education outcomes. This paper examines the contribution of School-Based Conservation Club Strength to Learner Conservation Understanding and Engagement (LCUE) in Kenyan primary schools. Addressing measurement gaps in the literature, the study developed and applied two integrated frameworks: a seven-dimension Conservation Club Strength framework and a nine-dimension Learner Conservation Understanding and Engagement framework. A post-positivist sequential explanatory mixed-methods design was employed, with data collected from 59 primary schools across Kenya's Tsavo Landscape. Instrument reliability was satisfactory (LCUE: $\alpha = 0.768$, $\omega = 0.817$; Club Strength: $\alpha = 0.756$, $\omega = 0.775$). Ordinary Least Squares regression revealed a positive and statistically significant relationship between Conservation Club Strength and LCUE ($\beta = 0.304$, $p = 0.040$). Although the effect size was modest ($R^2 = 0.072$), the findings suggest that stronger conservation clubs provide more supportive environments for conservation learning, participation, and environmental action. The paper advances conservation education research by providing integrated multidimensional measures for assessing learner conservation outcomes and the organizational attributes of school-based conservation clubs.

Introduction

Biodiversity loss, habitat degradation, climate change, pollution, and unsustainable resource use have intensified the need for effective conservation education as a strategic response to contemporary environmental challenges. Conservation education seeks to equip individuals and communities with the knowledge, values, skills, attitudes, and behaviours required to promote biodiversity conservation and sustainable interactions with the natural environment while fostering informed decision-making and environmental stewardship (Jacobson & Hardesty, 1988; Kobori, 2009). Increasingly, it is recognized as a critical mechanism for advancing wildlife protection, habitat restoration, ecosystem resilience, sustainable natural resource management, climate change adaptation, and broader sustainability objectives (Mbugua, 2012; Sutherland, 2017; Kamaludin et al., 2021; Imran et al., 2024). Its relevance extends beyond environmental protection to the global sustainable development agenda through its contribution to Sustainable Development Goals (SDGs) related to quality education, responsible consumption and production, climate action, life on land, clean water and sanitation, sustainable cities and communities, and life below water. As such, conservation education provides an important pathway through which environmental literacy can be translated into responsible behaviour, civic participation, and collective action for sustainability.

Evidence from diverse contexts suggests that experiential, participatory, and community-oriented approaches are particularly effective in strengthening environmental understanding and promoting conservation engagement (Lukas et al., 2019). Consequently, schools have emerged as one of the most important platforms for conservation education because they provide structured opportunities for learning, mentorship, skills development, value formation, and participation in collective environmental

action. Environmental values, stewardship orientations, and conservation behaviours are especially amenable to development during childhood and adolescence, when lifelong beliefs and behavioural dispositions are still being formed (Lukas et al., 2019; Huy & Sharma, 2017; Mbugua, 2012). This perspective is reflected in Kenya's environmental policy framework, which identifies environmental education and public awareness as critical instruments for addressing biodiversity loss, environmental degradation, climate change, pollution, ecosystem decline, and unsustainable consumption patterns. In a context where rapid urbanization, changing land-use practices, habitat loss, and growing pressure on natural resources continue to threaten wildlife and ecosystems, school-based conservation education assumes particular significance in nurturing an informed and environmentally responsible generation capable of contributing to sustainable environmental management.

Among the various approaches used to promote conservation learning within schools, school-based conservation clubs have become an important vehicle for translating conservation education objectives into practical educational experiences. These clubs include wildlife clubs, eco-clubs and green clubs. Operating alongside the formal curriculum, conservation clubs provide learners with opportunities to participate in environmental learning, conservation action, leadership development, and environmental stewardship through activities such as nature observation, conservation projects, environmental awareness campaigns, tree planting, advocacy initiatives, school-community outreach programmes, and other experiential learning activities (Mbugua, 2012; Roberts, 2009; Zhang et al., 2017). In Kenya, conservation clubs are rooted in a longstanding conservation education tradition that recognizes the importance of fostering public understanding, positive environmental attitudes, and active participation in conservation efforts from an early age (Mbugua, 2012). By connecting classroom learning with practical engagement, conservation clubs create environments through which learners can interact directly with conservation issues, develop conservation competencies, and participate in addressing environmental challenges within their schools and communities.

Existing evidence suggests that participation in environmental and conservation clubs is associated with improved environmental knowledge, stronger conservation attitudes, enhanced environmental responsibility, increased participation in conservation activities, higher levels of self-efficacy, and greater environmental action competence (Roberts, 2009; Zhang, Zhao & Chen, 2019; Yildirim & Akar, 2021; Park & Kim, 2020). Despite these findings, important gaps remain within the literature. First, conservation education outcomes are commonly assessed as separate constructs rather than as components of an integrated measure of learner conservation competence. Second, although leadership, resources, mentorship, partnerships, outreach activities, and innovation are frequently identified as important characteristics of effective conservation clubs, these attributes are rarely combined into a multidimensional measure of club strength. Consequently, limited empirical evidence exists regarding the extent to which variations in conservation club strength influence multidimensional conservation education outcomes, particularly within the Kenyan primary school context.

Against this background, this study examined the contribution of School-Based Conservation Club Strength to Learner Conservation Understanding and Engagement (LCUE) in Kenyan primary schools.

Specifically, the study sought to generate empirical evidence on the extent to which variations in club strength are associated with differences in learner conservation outcomes. The findings contribute to the growing body of knowledge on conservation education while informing policy and practice aimed at strengthening environmental learning and youth engagement in conservation.

Conservation Education Outcomes: Evidence from the Literature

The conservation education literature increasingly recognizes that effective conservation requires more than the transfer of ecological knowledge. Contemporary scholarship conceptualizes conservation education as a multidimensional process that seeks to cultivate environmental understanding, positive conservation values, stewardship behaviours, practical action competencies, and active participation in environmental governance and sustainability initiatives (Kobori, 2009; Sutherland, 2017; Schilbert & Scheersoi, 2022; Imran, Almusharraf & Abdellatif, 2024). Across formal and non-formal educational settings, conservation education is viewed not merely as an awareness-raising enterprise but as a mechanism for developing environmentally responsible citizens capable of contributing to biodiversity conservation and sustainable resource management.

A dominant theme emerging from the literature is the centrality of conservation understanding as the foundation upon which environmental attitudes and behaviours are built. Studies consistently emphasize environmental literacy, biodiversity awareness, ecological understanding, and appreciation of ecosystem services as core conservation education outcomes. Learners are expected to develop an understanding of the ecological, economic, and social importance of conserving wildlife, habitats, and natural resources, while simultaneously recognizing the consequences of environmental degradation, unsustainable resource use, and biodiversity loss (Kobori, 2009; Mbugua, 2012; Sutherland, 2017; Huoponen, 2024; Imran et al., 2024). Recent scholarship has expanded this understanding beyond traditional wildlife conservation to encompass broader sustainability concerns, including environmental responsibility, sustainable development, and intergenerational stewardship. In particular, Imran et al. (2024) demonstrate that environmental education contributes significantly to the development of environmental awareness, sustainable values, and environmental responsibility among learners, while equipping them with knowledge and skills necessary to address emerging sustainability challenges.

Beyond knowledge acquisition, the literature underscores the importance of experiential and action-oriented learning approaches in shaping conservation outcomes. Conservation education programmes increasingly incorporate practical engagement opportunities through which learners apply conservation knowledge in real-world contexts. Such activities include biodiversity monitoring, tree planting, reforestation, wetland restoration, mangrove rehabilitation, environmental campaigns, recycling programmes, wildlife clubs, eco-clubs, citizen science projects, conservation fairs, and field-based environmental learning experiences (Kobori, 2009; Mbugua, 2012; Wright, Kling & Cornejo, 2017; Huy & Sharma, 2017; Kamaludin et al., 2021). The shift toward participatory learning reflects growing recognition that conservation competence is developed not only through cognitive learning but also through direct engagement with environmental issues. Evidence from environmental club programmes is

particularly compelling. Huoponen (2024), for example, demonstrates that eco-clubs provide structured opportunities for learners to undertake environmental action, influence sustainability practices within schools, develop leadership and collaborative skills, and strengthen pro-environmental behaviour. Such findings suggest that practical participation serves as an important bridge between environmental awareness and environmental action.

The literature further indicates that conservation education seeks to develop learners' capacity to identify and critically evaluate environmental threats affecting biodiversity and ecosystem sustainability. Across diverse contexts, learners are exposed to conservation challenges including habitat destruction, biodiversity loss, poaching, invasive species, illegal wildlife trade, deforestation, pollution, wetland degradation, urbanization, unsustainable land-use practices, environmental disasters, and human-wildlife conflict (Lukas et al., 2019; Mbugua, 2012; Wright et al., 2017; Kamaludin et al., 2021). This emphasis reflects the premise that effective environmental stewardship requires not only understanding ecological systems but also recognizing the threats that undermine them. More recent studies have extended this focus to encompass climate-induced environmental risks, global warming, and environmental vulnerability. Imran et al. (2024), for instance, highlight the importance of educating learners about climate-related disasters, environmental pollution, and unsustainable development trajectories, reflecting a broader shift toward integrating planetary sustainability concerns into conservation education.

Closely related to threat awareness is the growing emphasis on solution-oriented conservation learning. Rather than focusing solely on environmental problems, contemporary conservation education increasingly seeks to strengthen learners' capacity to identify, support, and implement practical conservation responses. The literature highlights a wide range of conservation solutions, including ecosystem restoration, habitat protection, environmental stewardship, conservation leadership, community conservancies, sustainable agriculture, ecotourism, environmental awareness campaigns, and school-based environmental action programmes (Kobori, 2009; Mbugua, 2012; Wright et al., 2017; Huy & Sharma, 2017; Kamaludin et al., 2021). This solution-oriented orientation reflects a broader pedagogical shift from passive environmental awareness toward learner empowerment and environmental problem-solving. Evidence from eco-club studies further suggests that learners can play a meaningful role in designing and implementing environmental actions capable of improving sustainability practices within their schools and communities (Huoponen, 2024).

Another significant strand of the literature concerns the social dimensions of conservation education. Conservation is increasingly understood as a collective endeavour requiring collaboration among individuals, institutions, and communities. Consequently, community engagement features prominently as both a learning process and an intended conservation outcome. Across the reviewed studies, conservation programmes foster partnerships involving schools, families, local communities, conservation agencies, civil society organizations, and government institutions through environmental campaigns, community restoration initiatives, conservancy programmes, school-community partnerships, and stakeholder engagement activities (Kobori, 2009; Mbugua, 2012; Wright et al., 2017; Huy & Sharma, 2017; Jokilehto, 2007). Imran et al. (2024) similarly emphasize the role of parent-teacher

collaboration, community engagement programmes, green societies, and extracurricular environmental activities in cultivating environmental responsibility among young people. Collectively, these studies suggest that conservation competence is not solely an individual attribute but is also shaped by social participation and collective action processes.

The literature also highlights the importance of institutional and governance dimensions within conservation education. Effective conservation is consistently linked to the presence of supportive institutional arrangements, policy frameworks, and governance structures. Studies reference the contributions of wildlife authorities, conservation agencies, protected areas, educational institutions, conservation NGOs, community conservancies, environmental education policies, and international conservation conventions in advancing conservation objectives (Jokilehto, 2007; Mbugua, 2012; Huy & Sharma, 2017; Huoponen, 2024; Imran et al., 2024). Although less extensively studied than knowledge and participation outcomes, these institutional dimensions underscore the importance of helping learners understand how conservation systems function and how environmental decisions are shaped by formal governance arrangements.

A notable development within contemporary conservation education research is the increasing integration of climate change education. While early conservation education programmes primarily focused on biodiversity conservation and wildlife protection, recent scholarship increasingly incorporates climate literacy, ecosystem resilience, environmental adaptation, climate action, and sustainability education. Sutherland (2017) explicitly situates climate change within broader conservation learning, while Kamaludin et al. (2021) demonstrate the contribution of mangrove conservation to climate regulation and ecosystem resilience. Similarly, Imran et al. (2024) report widespread support among educators for integrating climate change education and environmental sustainability into formal learning programmes. These developments reflect growing recognition that biodiversity conservation and climate resilience are fundamentally interconnected challenges requiring integrated educational responses.

Emerging areas within the literature include sustainable waste management and technology-enabled conservation. Although these dimensions receive comparatively less attention than biodiversity conservation and environmental stewardship, evidence increasingly points to their relevance within contemporary conservation education. Studies discuss recycling initiatives, litter collection activities, environmental cleanliness campaigns, plastic waste reduction, waste awareness programmes, and application of the Reduce-Reuse-Recycle (3R) principles as important components of environmental sustainability education (Huy & Sharma, 2017; Wright et al., 2017; Imran et al., 2024). Similarly, technological innovations are becoming increasingly visible within conservation learning through biodiversity monitoring systems, environmental communication platforms, educational media, digital learning resources, social media campaigns, environmental applications, and technology-enabled environmental monitoring initiatives. Wright et al. (2017) and Imran et al. (2024) provide evidence that digital technologies can enhance environmental learning, broaden public awareness, and facilitate participation in conservation activities.

Two studies are especially significant in advancing contemporary understanding of learner conservation outcomes. Huoponen (2024) extends conservation education beyond knowledge acquisition by demonstrating how environmental clubs contribute to learner empowerment, environmental identity formation, democratic participation, collaborative action, and sustainability leadership. Similarly, Imran et al. (2024) provide one of the most comprehensive articulations of the relationship between environmental education and conservation outcomes by linking environmental learning to sustainable values, climate literacy, environmental stewardship, community engagement, teacher preparation, field-based learning, sustainability projects, and environmental policy development. Together, these studies illustrate the increasingly integrated nature of conservation competence and reinforce the view that effective conservation education encompasses cognitive, behavioural, social, and institutional dimensions simultaneously.

Taken together, the evidence suggests that conservation education has evolved into a multidimensional field concerned not only with what learners know about conservation but also with how they engage with environmental challenges, participate in conservation action, collaborate with communities, navigate institutional systems, and contribute to sustainability transitions. The literature therefore supports a broad conceptualization of conservation outcomes that incorporates knowledge, attitudes, values, participation, stewardship, environmental action, governance awareness, climate literacy, and emerging technological competencies as mutually reinforcing components of learner conservation competence.

Despite the growing body of conservation education research, a significant measurement gap remains within the literature. Existing studies provide substantial evidence that conservation education contributes to improvements in environmental knowledge, awareness, attitudes, stewardship values, participation in conservation activities, and environmental responsibility (Kobori, 2009; Sutherland, 2017; Wright et al., 2017; Imran et al., 2024). However, these outcomes are typically examined as separate constructs and are rarely assessed within a unified analytical framework.

A review of the literature reveals that most conservation education studies tend to follow one of three broad assessment traditions. The first focuses on conservation knowledge and environmental literacy, examining what learners know about biodiversity, environmental challenges, and sustainability issues. The second emphasizes attitudes, values, and behavioural intentions, assessing learners' environmental orientations and commitment to conservation. The third focuses on participation and action competence, examining learner engagement in conservation activities, stewardship behaviours, and environmental action (Kobori, 2009; Lukas et al., 2019; Schilbert & Scheersoi, 2022). While each of these approaches contributes valuable insights, they are generally applied independently and therefore provide only a partial view of learner conservation competence.

Consequently, few studies attempt to develop or validate comprehensive multidimensional measures capable of simultaneously capturing the diverse outcomes that conservation education programmes seek to achieve. Important dimensions such as conservation understanding, participation in conservation activities, awareness of environmental threats, identification of conservation solutions,

sustainable waste management, institutional awareness, community engagement, climate literacy, and technology-enabled conservation are typically assessed separately rather than as components of an integrated construct. This fragmentation limits the ability to generate a holistic assessment of learner conservation competence and constrains comparative evaluation across conservation education programmes.

This study addressed this gap through the development and application of the Learner Conservation Understanding and Engagement (LCUE) score. Drawing on evidence from the conservation education literature, the framework integrated nine interrelated dimensions of conservation competence encompassing conservation understanding, practical engagement, threat awareness, conservation solutions, waste management, institutional awareness, community participation, climate change, and technology-enabled conservation. By bringing these dimensions together within a single measurement framework, the study provides a more comprehensive approach to assessing conservation education outcomes and responds directly to an important gap in the existing conservation education literature.

School-Based Conservation Clubs and Conservation Education Outcomes

School-based conservation clubs have become important mechanisms for delivering conservation education by providing structured environments through which learners acquire environmental knowledge, participate in conservation activities, develop leadership competencies, and engage in environmental stewardship. Although conservation education programmes are often evaluated in terms of their effects on learner knowledge, attitudes, and behaviours, an emerging body of evidence suggests that these outcomes are strongly influenced by the quality and functionality of the clubs through which conservation learning is delivered (Roberts, 2009; Zhang et al., 2017; Zhang, Zhao & Chen, 2019; Yildirim & Akar, 2021; Park & Kim, 2020). Rather than serving merely as extracurricular activities, wildlife and environmental clubs function as organizational platforms that facilitate experiential learning, environmental action, leadership development, and ecological citizenship.

The literature consistently indicates that effective clubs are characterized by a combination of organizational, programmatic, leadership, and resource-related attributes. Roberts (2009) demonstrates that successful eco-clubs are supported by clear organizational structures, effective teacher leadership, adequate educational resources, institutional backing, coordinated programme implementation, and strategic partnerships. Similarly, Zhang et al. (2017) and Zhang, Zhao and Chen (2019) show that structured nature clubs create opportunities for nature observation, biodiversity learning, environmental exploration, and practical conservation engagement. Collectively, these studies suggest that club effectiveness depends less on mere existence and more on the quality of systems and processes that support conservation learning.

A central theme across the literature is the importance of experiential and action-oriented learning. Through activities such as biodiversity monitoring, ecological investigations, environmental campaigns,

conservation projects, nature excursions, and community-based conservation initiatives, learners are able to apply environmental knowledge in practical settings. Such experiences are consistently associated with enhanced environmental understanding, stronger conservation values, and increased commitment to environmental stewardship (Zhang et al., 2017; Zhang, Zhao & Chen, 2019). Club participation therefore provides an important pathway through which conservation knowledge is translated into meaningful environmental action.

The effectiveness of these programmes is further strengthened by mentorship and adult guidance. Teacher patrons, environmental educators, and club coordinators play critical roles in facilitating learning, mobilizing resources, organizing activities, and maintaining learner engagement. Roberts (2009) identifies teacher leadership as a key determinant of club effectiveness, while later studies portray educators as mentors, project managers, facilitators of learner-led initiatives, and brokers of external partnerships (Yildirim & Akar, 2021; Park & Kim, 2020). These mentorship arrangements appear particularly important in enabling learners to progress from participation in environmental activities to environmental leadership and stewardship.

The literature also highlights the growing importance of outreach, advocacy, and community engagement within conservation clubs. While earlier club models focused primarily on environmental awareness and nature appreciation, more recent initiatives increasingly incorporate public engagement, environmental communication, advocacy campaigns, and community-based action. Yildirim and Akar (2021) demonstrate how climate change clubs enabled learners to design sustainability initiatives and influence environmental practices within their schools and communities. Similarly, Park and Kim (2020) show that Green Team programmes promoted ecological citizenship through environmental advocacy, peer education, school-wide sustainability initiatives, and collective action. These findings suggest that strong clubs extend conservation learning beyond individual knowledge acquisition by creating opportunities for learners to influence environmental behaviour within broader social systems.

Partnerships and collaborative networks emerge as another important feature of effective clubs. Relationships with conservation organizations, community groups, environmental agencies, and other external stakeholders provide access to technical expertise, educational resources, mentorship opportunities, and practical conservation experiences (Roberts, 2009; Yildirim & Akar, 2021). Such collaborations expose learners to real-world conservation practice while strengthening connections between school-based learning and broader environmental action.

Recent studies further emphasize innovation and sustainability as important dimensions of club effectiveness. Beyond programme continuity and institutional support, clubs increasingly engage learners in sustainability projects, environmental monitoring, carbon-footprint assessments, data-informed environmental decision-making, and school-wide sustainability reforms (Yildirim & Akar, 2021; Park & Kim, 2020). These developments reflect a shift toward more transformative forms of conservation education that emphasize problem-solving, creativity, critical thinking, and learner-led change.

Evidence linking club participation to learner outcomes is consistently positive. Across the reviewed studies, participation in environmental clubs is associated with improved environmental knowledge, stronger conservation attitudes, increased environmental responsibility, enhanced self-efficacy, greater involvement in conservation activities, stronger advocacy behaviours, and higher levels of environmental action competence (Roberts, 2009; Zhang, Zhao & Chen, 2019; Yildirim & Akar, 2021; Park & Kim, 2020). In particular, Zhang, Zhao and Chen (2019) demonstrate that participation in structured nature clubs contributes to measurable improvements in conservation behaviours, behavioural intentions, and learners' confidence to undertake environmental action. These findings suggest that environmental clubs play a critical role in connecting environmental awareness with conservation practice.

Despite this growing evidence base, significant conceptual and methodological gaps remain. Most studies focus primarily on learner outcomes while paying comparatively little attention to the organizational characteristics that make some clubs more effective than others. Although factors such as leadership, mentorship, educational resources, activity implementation, partnerships, outreach, and innovation are frequently identified as important contributors to club effectiveness, they are often examined separately and descriptively rather than as components of an integrated construct (Roberts, 2009; Zhang et al., 2017; Zhang, Zhao & Chen, 2019; Yildirim & Akar, 2021; Park & Kim, 2020).

The reviewed studies also conceptualize club effectiveness in different ways. Roberts (2009) emphasizes organizational capacity, leadership, institutional support, and programme management. Zhang et al. (2017) and Zhang, Zhao and Chen (2019) focus more strongly on learner participation, nature engagement, and behavioural outcomes. Yildirim and Akar (2021) emphasize innovation, sustainability initiatives, and institutional change, while Park and Kim (2020) foreground learner leadership, ecological citizenship, and environmental advocacy. Although these perspectives are complementary, no single study integrates them into a comprehensive framework for assessing club strength.

Consequently, an important measurement gap remains within the conservation club literature. Existing evidence suggests that effective clubs are characterized by multiple interconnected attributes, including governance structures, conservation programming, mentorship systems, educational resources, outreach mechanisms, partnerships, innovation processes, and leadership competencies. However, these dimensions have rarely been combined into a multidimensional measure capable of systematically explaining variations in learner conservation outcomes across different educational settings.

The present framework integrated these two streams of literature by linking a multidimensional measure of Conservation Club Strength with a multidimensional measure of Learner Conservation Understanding and Engagement. The model therefore provides a basis for examining how variations in club strength influence conservation education outcomes among learners.

Conceptual Framework and Hypothesis Development

The conceptual framework for this study integrated insights from the conservation education and school-based conservation club literature. The conservation education literature demonstrates that learner conservation competence is a multidimensional construct extending beyond environmental knowledge to include participation, stewardship, environmental problem-solving, community engagement, governance awareness, climate literacy, and technology-enabled conservation. Accordingly, this study operationalized conservation education outcomes through the Learner Conservation Understanding and Engagement (LCUE) score, a multidimensional framework comprising nine dimensions: understanding the importance of conservation, participation in conservation activities, awareness of environmental threats, knowledge of conservation solutions, sustainable waste management, institutional awareness, community engagement, climate change and nature protection, and technology-enabled conservation.

The literature on school-based conservation clubs further suggests that conservation outcomes are influenced by the quality and functionality of the organizational environments through which conservation education is delivered. Effective clubs are characterized by strong organizational structures, active conservation programming, mentorship systems, adequate educational resources, outreach and advocacy activities, collaborative partnerships, innovation mechanisms, and competent teacher leadership (Roberts, 2009; Zhang et al., 2017; Zhang, Zhao & Chen, 2019; Yildirim & Akar, 2021; Park & Kim, 2020). Drawing on these insights, the present study conceptualized School-Based Conservation Club Strength as a multidimensional organizational capacity construct comprising seven dimensions: club existence and documented workplan, conservation activities and mentorship, conservation education materials, outreach and advocacy, networks and collaborations, innovation and sustainability mechanisms, and teacher/patron conservation competencies.

The framework posits that stronger conservation clubs create richer learning environments that provide learners with greater opportunities for conservation learning, participation, leadership, and environmental action. Consequently, higher levels of School-Based Conservation Club Strength are expected to be associated with higher levels of Learner Conservation Understanding and Engagement. Accordingly, the study was guided by the following hypothesis:

H_1

School-Based Conservation Club Strength positively and significantly predicts Learner Conservation Understanding and Engagement (LCUE) in schools ($\beta_1 > 0$).

Methodology

Research Philosophy and Design

This study was anchored in the post-positivist research philosophy, which assumes that an objective reality exists independently of human perception but can only be understood imperfectly because observations and measurements are inevitably influenced by contextual factors, measurement error, and

researcher limitations (Phillips & Burbules, 2000; Creswell & Creswell, 2018). Unlike classical positivism, which assumes that reality can be measured with complete objectivity, post-positivism recognizes that knowledge is provisional and subject to continual refinement through empirical inquiry. Consequently, post-positivist research seeks to generate the most credible approximation of reality through systematic observation, rigorous measurement, theory-driven investigation, and the application of objective analytical procedures. This philosophical orientation was appropriate because the study sought to empirically examine the relationship between conservation club strength and learner conservation education outcomes in Kenyan primary schools. Specifically, the study was based on the premise that both Conservation Club Strength and Learner Conservation Understanding and Engagement (LCUE) are latent constructs that can be operationalized through observable indicators, measured systematically, and subjected to statistical analysis.

Consistent with this philosophical stance, the study adopted a cross-sectional mixed-methods design, implemented through a sequential explanatory approach. Quantitative data were collected and analysed first to establish patterns, relationships, and levels of school-based conservation club strength and learner conservation outcomes. This was followed by qualitative data collection aimed at explaining, contextualizing, and enriching the quantitative findings through participants' experiences, perceptions, and explanations of conservation club activities and their influence on learners. The integration of quantitative and qualitative evidence provided both breadth and depth of understanding, thereby strengthening the robustness and explanatory power of the findings.

Study Area, Population and Sampling

The study was conducted within the Tsavo Landscape of Kenya, encompassing the seven counties surrounding Tsavo National Park: Kajiado, Makueni, Kitui, Taita Taveta, Kwale, Kilifi, and Tana River. The area was selected because of its ecological significance, close proximity to wildlife conservation areas, and extensive implementation of conservation education programmes through school-based conservation clubs. The target population comprised 137 primary schools with established conservation clubs, which constituted the principal unit of analysis. Learners, conservation club members, teachers, and club patrons served as the primary sources of data regarding conservation education outcomes and club functionality.

A proportionate sampling strategy was employed to select participating schools from the target population. Proportionate allocation ensured that each county was represented according to its share of conservation club schools while maintaining adequate geographical coverage across the Tsavo Landscape. A total of 59 schools were selected, representing approximately 43% of the target population. This sample provided broad representation across the seven counties while remaining operationally feasible given the geographical extent of the study area and available field resources. The achieved sample also constituted a substantial proportion of the target population, thereby enhancing representativeness and the stability of school-level estimates. In addition, the sample size was adequate for the quantitative analyses undertaken in the study. The Ordinary Least Squares (OLS) regression

model used to examine the relationship between conservation club strength and school-level conservation outcomes included a single predictor variable (m = 1). According to Green's (1991) criterion, a minimum of 58 observations is required for a regression model with one predictor. The achieved sample of 59 schools exceeded this threshold and was therefore considered sufficient for estimating the specified model.

Within each sampled school, three learners were selected for assessment of the Learner Conservation Understanding and Engagement (LCUE) Score. In addition, at least 5 conservation club members, club patron(s), and where available at least one teacher supporting club activities, participated in the assessment of School-Based Conservation Club Strength in a Focus Group Discussion (FGD) setting. This approach facilitated the collection of data from both learner and club perspectives and enabled examination of the relationship between club strength and conservation education outcomes at the school level.

Data Collection Instruments and Procedures

Data collection employed both quantitative and qualitative instruments. The quantitative instruments were designed to measure the two principal constructs under investigation: Learner Conservation Understanding and Engagement (LCUE) and School-Based Conservation Club Strength. The LCUE instrument comprised nine dimensions: understanding the importance of conservation, participation in conservation activities, awareness of environmental threats, knowledge of conservation solutions, sustainable waste management, institutional awareness, community engagement, climate change and nature protection, and technology-enabled conservation. The Club Strength instrument comprised seven dimensions: club existence and documented workplans, conservation activities and mentorship structures, conservation education materials, outreach and advocacy activities, networks and collaborations, innovation and sustainability mechanisms, and teacher or patron conservation competencies. Qualitative instruments were developed to generate explanatory information regarding conservation club operations, learner experiences, and the contextual factors influencing conservation education outcomes. These instruments enabled deeper exploration of the mechanisms through which school-based conservation clubs influence learner understanding and engagement.

Data collection was undertaken by trained field teams operating across the seven study counties. Quantitative data collection preceded qualitative data collection in accordance with the sequential explanatory design. Following preliminary quantitative analysis, qualitative data were gathered to provide explanatory insights into observed patterns and relationships. This approach facilitated a richer understanding of how and why variations in school-based conservation club strength were associated with differences in learner conservation understanding and engagement.

Reliability of Study Instruments

Consistent with post-positivist principles emphasizing rigorous measurement and empirical validation, the reliability of the study instruments was assessed using measures of internal consistency. Specifically, Cronbach's alpha (α) and McDonald's omega (ω) were computed for both the LCUE and Club Strength instruments. Internal consistency reliability assesses the extent to which instrument dimensions consistently measure the same underlying construct. Cronbach's alpha values of 0.70 or higher are generally considered acceptable for research purposes (Nunnally & Bernstein, 1994), while McDonald's omega is increasingly recommended as a more robust indicator of composite reliability because it accommodates unequal factor loadings and does not assume that all dimensions contribute equally to the latent construct (McDonald, 1999; Hayes & Coutts, 2020). The actual reliability coefficients are reported under the Results section.

Data Analysis

Data analysis was conducted using both quantitative and qualitative techniques in line with the study's sequential explanatory mixed-methods design. Quantitative data were first coded, cleaned, and analysed to generate descriptive and inferential statistics. Descriptive analysis was used to summarize the characteristics and distribution of the study variables. Measures of central tendency and dispersion, including means, standard deviations, and coefficients of variation, were computed for the dimensions and composite indices of Learner Conservation Understanding and Engagement (LCUE) and School-Based Conservation Club Strength. The mean scores provided information on the average performance of schools across the measured dimensions, while standard deviations and coefficients of variation were used to assess the degree of variability and consistency in responses among sampled schools.

To facilitate interpretation, composite indices for LCUE and Club Strength were generated by aggregating the respective instrument dimensions. Composite indices for LCUE and Club Strength were generated by calculating the arithmetic mean of their respective dimension scores. For LCUE, the school-level score was derived by averaging the scores obtained from the three sampled learners. For Club Strength, a composite score was generated from the ratings assigned across the seven club-strength dimensions following a consensus assessment process involving the field team and respondents. These indices formed the basis for subsequent inferential analysis. The relationship between Club Strength and LCUE was examined using Ordinary Least Squares (OLS) regression analysis. OLS was considered appropriate because the study sought to determine the extent to which variations in school-based conservation club strength were associated with variations in learner conservation outcomes across schools. Regression coefficients, significance levels, and measures of model fit were used to assess the direction, strength, and statistical significance of the relationship between the independent variable (Club Strength) and the dependent variable (LCUE).

Prior to estimating the Ordinary Least Squares (OLS) regression model, diagnostic tests were conducted to assess compliance with the assumptions underlying linear regression. Normality of residuals was examined using skewness and kurtosis statistics. Consistent with the recommendations of Hair et al. (2019), skewness values within ± 2 and kurtosis values within ± 7 were considered indicative of

acceptable normality. Homoscedasticity was assessed through examination of standardized residual plots and the Breusch-Pagan test. These diagnostic procedures were undertaken to ensure the validity of the regression estimates and statistical inferences.

Qualitative data were analysed using thematic and pattern analysis. Interview and discussion notes were reviewed, coded, and organized into meaningful categories based on recurring ideas, experiences, and explanations provided by participants. Similar codes were grouped into broader themes that reflected key aspects of conservation club operations, learner experiences, factors influencing club effectiveness, and explanations for patterns observed in the quantitative findings. Pattern analysis was subsequently employed to identify relationships, consistencies, and contrasts across participant accounts. The qualitative results were then integrated with the quantitative findings to provide contextual explanations and enhance interpretation of the observed statistical patterns. Integration occurred during interpretation, where qualitative themes were used to explain and contextualize patterns emerging from the quantitative analysis. Through this combination of descriptive statistics, inferential analysis, and qualitative thematic inquiry, the study generated a comprehensive understanding of the contribution of school-based conservation clubs to conservation education outcomes in Kenyan primary schools. Quantitative data were analysed using SPSS version 25, while qualitative data were organized and analysed manually through thematic coding.

Ethical Considerations

Because the study involved children, ethical compliance and safeguarding were integral throughout the research process. Data collection was conducted in accordance with the requirements of the Children Act, 2022 (Cap. 141) of the laws of Kenya, the conditions of the National Commission for Science, Technology and Innovation (NACOSTI) research permit, and established ethical standards governing research involving minors. Institutional authorization was obtained from headteachers and conservation club patrons, while informed consent was secured from authorized school representatives. Child assent was obtained from all participating learners prior to their involvement in the study.

To safeguard participants, all learner interactions were conducted in the presence of teachers and data collection activities were organized to minimize disruption to normal school operations and instructional time. Enumerators received prior training on research ethics, child safeguarding, informed consent procedures, confidentiality requirements, and respectful engagement with Indigenous Peoples and Local Communities. Throughout the study, all information collected was treated as confidential and used exclusively for research purposes. These measures ensured the protection of participants' rights, dignity, safety, and well-being while maintaining the integrity of the research process.

Results

Respondent Profile

A total of 177 learners participated in the survey across the seven project counties. Makueni contributed the largest number of respondents (42), followed by Taita Taveta (39), Kitui (33), Kilifi (30), Kajiado (15), Kwale (12), and Tana River (6). Participation was almost evenly distributed by sex, comprising 88 males (49.7%) and 89 females (50.3%), with generally balanced gender representation across counties. Although minor variations were observed, including relatively higher female participation in Kajiado and higher male participation in Kitui, the overall distribution provided broad geographical coverage and balanced representation across the study area. The respondents were drawn primarily from upper primary and junior school grades. Grade 8 and Grade 9 learners constituted the largest proportion of the sample, with 48 learners each, collectively accounting for 54.2% of all respondents. Grade 7 contributed 29 learners (16.4%), while Grade 6 accounted for 22 learners (12.4%). Lower grades were less represented, with Grades 2 to 5 collectively accounting for 16.9% of the sample. Overall, approximately 83% of respondents were drawn from Grades 6–9, reflecting the study's focus on learners who were more likely to have been exposed to conservation education activities and who were better positioned to articulate their experiences, perceptions, and learning outcomes.

In addition, 457 participants contributed to the assessment of conservation club strength across the seven project counties, comprising 288 conservation club members, 96 club patrons, and 73 teachers. Club members constituted the largest participant category, reflecting the study's emphasis on learner participation in conservation club activities. The inclusion of patrons and teachers provided complementary perspectives on club organization, implementation, and institutional support, thereby enabling a more comprehensive assessment of conservation club strength within participating schools.

Instrument Reliability

The reliability of the study instruments was assessed using both Cronbach's alpha (α) and McDonald's omega (ω). McDonald's omega was examined alongside Cronbach's alpha because it provides a more robust estimate of composite reliability when item contributions are not perfectly equivalent. Consistent with commonly accepted criteria, values of α and ω ≥ .70 were considered acceptable, values ≥ .80 good, and values ≥ .90 excellent (Hair et al., 2019; Hayes & Coutts, 2020). The nine-dimension Learner Conservation Understanding and Engagement (LCUE) instrument yielded a Cronbach's alpha coefficient of 0.768 and a McDonald's omega coefficient of 0.817. Both coefficients exceeded the minimum acceptable threshold of 0.70, while the omega coefficient surpassed the 0.80 benchmark for good reliability. These results indicate that the dimensions exhibited satisfactory internal consistency and collectively provided a reliable measure of learner conservation understanding and engagement. Similarly, the seven-dimension Club Strength instrument produced a Cronbach's alpha coefficient of 0.756 and a McDonald's omega coefficient of 0.775. Both coefficients exceeded the recommended threshold of 0.70, indicating acceptable reliability and demonstrating that the dimensions consistently measured the underlying construct of conservation club strength. The relatively small differences between alpha and omega coefficients for both instruments suggest that the constituent dimensions contributed fairly uniformly to their respective scales.

Overall, the reliability coefficients provide evidence that both instruments possessed adequate internal consistency and were suitable for subsequent statistical analyses. The observed reliability levels indicate that variations in LCUE and Club Strength scores are unlikely to be attributable primarily to random measurement error, thereby enhancing confidence in the study's findings and conclusions regarding the relationship between conservation club strength and conservation education outcomes.

Descriptive Analyses of LCUE and Club Strength Scores

The study examined both learner-level outcomes and the effectiveness of school-based conservation structures. Data were collected on learners' conservation knowledge, awareness, attitudes, practical skills, participation in conservation activities, understanding of conservation challenges and solutions, awareness of conservation institutions, appreciation of the link between conservation and climate change, and knowledge of the role of technology in conservation. These indicators were aggregated into a Learner Conservation Score with a maximum score of 27 points, categorizing learners as having low (1–9 points), medium (10–18 points), or high (19–27 points) levels of conservation understanding and engagement. The assessment also examined the functionality and sustainability of conservation clubs, including their continuity and record-keeping practices, implementation of conservation activities, mentorship arrangements, availability and utilization of educational resources, outreach and advocacy efforts, participation in conservation networks, innovation and sustainability initiatives, and teacher competence in delivering conservation education. These dimensions were aggregated into a Club Strength Score with a maximum of 21 points, classifying clubs as weak (1–7 points), moderate (8–14 points), or strong (15–21 points).

The scores were first aggregated at the school level and then combined to generate county-level mean scores. Relative variability within each county was assessed using the Coefficient of Variation (CV). The results are presented in the Table 1. The analysis revealed notable variation in the extent to which conservation education has been institutionalized and sustained across the project counties. Based on the established scoring benchmarks, Kilifi (M = 20.17) and Kajiado (M = 20.07) recorded the highest mean learner conservation understanding and engagement scores, placing learners in both counties within the high conservation category. Kitui also achieved a mean score within the high category (M = 19.15). In contrast, Makueni (M = 18.04), Tana River (M = 17.33), Kwale (M = 14.46), and Taita Taveta (M = 14.06) fell within the medium conservation category, indicating comparatively lower levels of conservation understanding and engagement.

At the school level, only 22 of the 59 assessed schools (37.3%) attained scores within the high LCUE category. These comprised six schools in Makueni, six in Kilifi, six in Kitui, and four in Kajiado. The findings suggest that, while a number of schools have achieved high conservation scores, performance remains uneven across counties and individual schools. The weakest areas of performance relate to learners' understanding of community participation in conservation and the linkages between conservation and climate change, particularly the importance of community involvement in conservation efforts and the role of ecosystem and biodiversity conservation in climate change mitigation.

Table 1
County-level Scores and Their Variability

County	n	Mean LCUE Score	SD	CV (%)	Mean Club Strength Score	SD	CV (%)
Kajiado	5	20.07	1.75	8.7	15.20	1.92	12.7
Kilifi	9	20.17	1.77	8.8	15.67	3.50	22.3
Kitui	11	19.15	2.99	15.6	14.55	3.14	21.6
Kwale	3	14.46	0.83	5.7	11.33	1.53	13.5
Makueni	16	18.04	2.53	14.0	12.81	1.38	10.7
Taita Taveta	13	14.06	1.75	12.4	14.85	2.85	19.2
Tana River	2	17.33	0.47	2.7	12.50	3.54	28.3

A similar pattern was evident in relation to conservation club performance. Kilifi (M = 15.67) and Kajiado (M = 15.20) attained mean club strength scores within the strong category, indicating relatively robust conservation structures characterized by active programming, effective utilization of educational resources, and sustained learner participation. Taita Taveta (M = 14.85) and Kitui (M = 14.55) were positioned at the upper end of the moderate category, suggesting well-established clubs with considerable potential for further strengthening. Makueni (M = 12.81), Tana River (M = 12.50), and Kwale (M = 11.33) also fell within the moderate category, reflecting functional clubs whose effectiveness may be influenced by contextual and implementation constraints. At the school level, 21 of the 59 assessed schools (35.6%) achieved scores within the strong club category, comprising two schools in Makueni, four in Kilifi, four in Kitui, four in Kajiado, and seven in Taita Taveta.

While these findings demonstrate the successful establishment and operation of conservation clubs in a substantial proportion of schools, they also highlight areas requiring further attention to enhance sustainability and effectiveness. The principal constraints identified across schools included inadequate availability and diversity of conservation education materials for both learners and communities, weak mechanisms for club continuity through limited record-keeping and portfolio development, low levels of outreach and advocacy activities, and an insufficient number of teachers trained in conservation education content and pedagogy.

The coefficients of variation provide additional insight into the consistency of outcomes across schools within each county. LCUE scores exhibited relatively low variability, with coefficients of variation ranging from 2.7% in Tana River to 15.6% in Kitui. The comparatively low variation observed in Kajiado (8.7%) and Kilifi (8.8%) indicates that conservation learning outcomes were achieved relatively consistently across participating schools. In contrast, Kitui (15.6%) and Makueni (14.0%) recorded greater variation, suggesting differences in programme implementation or school-level conditions that may have influenced learner outcomes. Greater disparities were observed in school-based conservation club

strength scores. Tana River recorded the highest coefficient of variation (28.3%), although this finding should be interpreted cautiously given the small number of schools assessed. Substantial variation was also evident in Kilifi (22.3%) and Kitui (21.6%), indicating that some schools had highly functional clubs while others were performing less strongly. By comparison, Makueni recorded the lowest variation in club strength (10.7%), suggesting a relatively uniform level of club functionality across participating schools.

Overall, the findings point to a positive association between the strength of conservation clubs and LCUE. Counties that recorded strong club strength scores, particularly Kilifi and Kajiado, also achieved the highest LCUE scores, suggesting that effective and well-supported conservation clubs contribute to stronger conservation learning outcomes. While these descriptive patterns indicate a potential relationship between club strength and learner conservation outcomes, inferential analysis was undertaken to test the statistical significance of this association. The results are presented in the following section.

Inferential Analysis

The study sought to examine whether conservation club strength significantly predicts learner conservation understanding and engagement in primary schools. To answer this question, the following hypothesis was tested at the 95% Confidence Level:

H_1

School-Based Conservation Club Strength positively and significantly predicts Learner Conservation Understanding and Engagement (LCUE) in schools ($\beta_1 > 0$).

The model was specified as: $\mathbf{LCUE_i = \beta_0 + \beta_1(Club\ Strength)_i + \varepsilon_i}$

where:

- Dependent variable: LCUE Score
- Independent variable: Club Strength Score
- Sample size: 59 schools

Prior to conducting the Ordinary Least Squares (OLS) regression analysis, diagnostic tests were performed to assess whether the data satisfied key model assumptions. Specifically, the analysis examined normality, which refers to whether regression errors are distributed in an approximately symmetric, bell-shaped pattern around zero, and homoscedasticity, which refers to whether the variance of prediction errors remains relatively constant across all values of the predictor variable. The normality assumption was assessed using skewness, kurtosis, and the Jarque-Bera test. The residuals exhibited a skewness coefficient of 0.034 and a kurtosis coefficient of 2.267, both of which fall comfortably within the thresholds of ± 2 for skewness and ± 7 for kurtosis recommended by Hair et al. (2019). The Jarque-Bera test was not statistically significant (JB = 1.476, p = 0.478), indicating no evidence of departure

from normality. These results suggest that the residuals were approximately normally distributed, thereby satisfying the normality assumption of OLS regression.

Homoscedasticity was assessed using the Breusch-Pagan test. The results showed that the test was not statistically significant (LM = 1.375, p = 0.241). Because the p-value exceeded the conventional significance threshold of 0.05, the null hypothesis of constant error variance could not be rejected. This indicates that the residual variance remained reasonably constant across fitted values and that there was no statistically significant evidence of heteroscedasticity. Thus, the diagnostic tests provided evidence that the principal assumptions underlying the OLS model were adequately satisfied. Consequently, the use of OLS regression to examine the relationship between School-Based Conservation Club Strength and Learner Conservation Understanding and Engagement (LCUE) was considered appropriate.

The regression output from the SPSS software is shown below:

Parameter	Coefficient (β)	Std. Error	t-value	p-value
Constant	13.371	2.080	6.428	< 0.001
Club Strength	0.304	0.144	2.102	0.040
The following accompanying statistics were also derived:				

Statistic	Value
R^2	0.072
Adjusted R^2	0.056
F-statistic	4.417
p-value (F-test)	0.040
N	59

Because the p-value (0.040) was below the significance threshold of 0.05, the null hypothesis was rejected, indicating a statistically significant positive relationship between conservation club strength and LCUE at the 5% level. The coefficient for Club Strength ($\beta_1 = 0.304$, p = 0.040) suggests that a one-unit increase in club strength is associated with an average increase of approximately 0.304 points in the LCUE score. Since the p-value is less than 0.05, the relationship is statistically significant. Given the Coefficient of Determination (R^2) of 0.072, the model explains approximately 7.2% of the observed variation in LCUE scores. While statistically significant, this indicates that other factors beyond club strength also contribute substantially to differences in learner conservation understanding and engagement across schools.

The explanatory power of the model was determined by calculating the effect size of the relationship between conservation club strength and learner conservation understanding and engagement using Cohen's f^2. Based on the regression coefficient of determination ($R^2 = 0.072$), Cohen's f^2 was calculated as follow:

$$f^2 = \frac{R^2}{1 - R^2} = \frac{0.072}{1 - 0.072} = 0.078.$$

According to Cohen's (1988) benchmarks, the effect size is small, although it approaches the threshold for a medium effect, indicating that conservation club strength accounts for a modest proportion of the variation in learner conservation understanding and engagement. Given the modest effect size observed, larger samples may improve the precision and statistical sensitivity of future studies.

Overall, the results demonstrate that school-based conservation clubs in the study area exhibited moderate to strong levels of functionality, while learner conservation understanding and engagement varied across counties and schools. Instrument reliability was satisfactory, diagnostic tests supported the use of OLS regression, and conservation club strength was found to be positively and significantly associated with learner conservation understanding and engagement. Although the relationship was statistically significant, the effect size was small, suggesting that additional school, community, and contextual factors may also influence conservation learning outcomes.

Qualitative Explanations of Variation in Conservation Club Effectiveness

Findings from school-level FGDs with club members, patrons and other teachers provided important insights into the factors underlying variations in learner conservation understanding and engagement across schools. A dominant theme was the importance of institutionalization. Schools demonstrating the strongest conservation outcomes had embedded conservation education within school structures, routines, and leadership systems. In these schools, conservation extended beyond awareness creation and was characterized by active conservation clubs, learner-led initiatives, practical environmental projects, and sustained administrative support. Conservation had effectively become part of the school culture rather than an isolated extracurricular activity.

A second theme concerned learner ownership and leadership. Schools reporting stronger conservation outcomes consistently created opportunities for learners to assume responsibility for environmental activities through stewardship roles, peer mentorship, and structured leadership arrangements. Approaches such as inter-grade tree stewardship and deliberate succession planning strengthened accountability, continuity, and long-term participation. These findings suggest that meaningful learner engagement is enhanced when students actively lead conservation activities rather than merely participate in them.

Experiential learning also emerged as a key driver of conservation understanding and engagement. Schools integrated environmental education with practical activities including tree nurseries, school gardens, poultry projects, seedling distribution, waste management initiatives, and recycling programmes. Such activities enabled learners to apply environmental knowledge to real-world challenges, thereby strengthening both understanding and commitment to conservation action.

A further theme was the importance of community and stakeholder engagement. The strongest schools extended conservation activities beyond school boundaries through community sensitization campaigns, household tree planting, market clean-ups, and partnerships with conservation agencies. These initiatives positioned learners as environmental ambassadors while reinforcing community ownership of conservation efforts. Effective collaboration between schools, communities, conservation agencies, and education stakeholders appeared to strengthen programme implementation and sustainability.

Climate-smart conservation practices also emerged as an important enabling factor, particularly in arid and semi-arid areas. Schools adopted locally appropriate strategies such as rainwater harvesting, drip irrigation, mulching, soil-moisture conservation measures, and the cultivation of drought-tolerant species. These innovations enhanced the resilience and sustainability of conservation activities despite environmental constraints. Conversely, schools reporting weaker conservation outcomes were characterized by weak club structures, limited learner ownership, poor documentation, resource constraints, and excessive dependence on individual champions. These findings suggest that conservation initiatives are less likely to be sustained where they are insufficiently institutionalized or lack broader organizational support.

Finally, participants identified broader benefits arising from conservation education beyond the intended learner outcomes. Teachers and club patrons reported increased professional recognition, leadership opportunities, and career progression associated with their involvement in conservation activities. These unintended outcomes appear to strengthen institutional commitment by providing additional incentives for sustained participation in conservation education.

Overall, the qualitative findings indicate that successful conservation education is shaped not only by environmental knowledge but also by the extent to which conservation is institutionalized through learner ownership, experiential learning, community engagement, climate-smart innovation, stakeholder collaboration, and supportive leadership structures. These factors help explain why schools with stronger conservation club systems tend to demonstrate higher levels of learner conservation understanding and engagement.

Discussion

The findings indicate that learners in participating schools generally demonstrated moderate to high levels of conservation understanding and engagement, while conservation clubs exhibited moderate to strong levels of functionality. However, substantial variation was observed across schools, suggesting

that conservation education outcomes are not determined solely by the presence of conservation clubs but also by differences in how such clubs are organized, supported, and integrated into school life. These findings are consistent with contemporary conservation education literature, which conceptualizes conservation learning as a multidimensional process requiring experiential learning, participation, institutional support, and opportunities for environmental action rather than the simple transmission of environmental knowledge (Kobori, 2009; Sutherland, 2017; Schilbert & Scheersoi, 2022; Imran et al., 2024). The variability observed across schools further supports arguments that differences in educational environments and implementation quality can significantly influence conservation outcomes among learners.

A key insight emerging from the study is that stronger conservation outcomes appear to be associated with the extent to which conservation activities are institutionalized within school systems. Schools exhibiting stronger learner conservation understanding and engagement were characterized not only by active conservation clubs but also by regular conservation activities, effective learner participation, teacher mentorship, administrative support, and integration of conservation into routine school practices. The qualitative findings help explain this relationship by showing that stronger clubs were characterized by institutionalized conservation structures, learner ownership, experiential learning opportunities, stakeholder support, and community engagement. This finding aligns with Roberts' (2009) argument that effective environmental clubs depend on supportive organizational structures, institutional backing, coordinated programme implementation, and strong teacher leadership. It also supports the broader experiential and participatory learning perspectives highlighted by Kobori (2009), Huy and Sharma (2017), and Huoponen (2024), which emphasize that meaningful conservation competence develops through sustained engagement and practical participation rather than awareness creation alone.

The relatively high learner conservation scores recorded in many schools provide further support for previous studies identifying school-based conservation clubs as important platforms for conservation learning and environmental action. Research has consistently demonstrated that participation in environmental clubs contributes to improvements in environmental knowledge, conservation attitudes, environmental responsibility, self-efficacy, environmental action competence, and stewardship behaviour (Roberts, 2009; Zhang, Zhao & Chen, 2019; Yildirim & Akar, 2021; Park & Kim, 2020). The present findings extend this evidence by suggesting that conservation clubs contribute not only to environmental awareness but also to learners' ability to translate conservation knowledge into practical engagement. Activities such as environmental restoration, conservation projects, environmental communication, and community outreach appear to provide opportunities through which learners apply conservation concepts in real-world situations, thereby strengthening both understanding and engagement.

The findings further underscore the importance of learner ownership and leadership in achieving meaningful conservation outcomes. Qualitative evidence suggests that schools demonstrating stronger conservation outcomes often employed structures that encouraged learner responsibility, peer mentorship, leadership succession, and active participation in implementation processes. These

observations reinforce the arguments advanced by Huoponen (2024), who found that environmental clubs contribute not only to environmental knowledge but also to learner empowerment, sustainability leadership, democratic participation, and collaborative action. Similarly, Park and Kim (2020) emphasize learner leadership and ecological citizenship as essential attributes of effective environmental programmes. The present findings therefore suggest that participation functions both as an outcome and as a mechanism through which conservation learning occurs.

The study also highlights the significance of experiential learning as a pathway through which conservation clubs influence learner outcomes. Schools reporting stronger conservation understanding and engagement frequently combined environmental education with practical conservation activities such as tree growing, school gardens, environmental rehabilitation, waste management, recycling, and resource conservation initiatives. These findings are consistent with Kobori (2009), Huy and Sharma (2017), Wright et al. (2017), and Huoponen (2024), all of whom emphasize the value of field-based, practical, and action-oriented environmental education. Such experiential activities allow learners to connect environmental concepts with observable outcomes, thereby strengthening environmental understanding, stewardship values, and conservation action competence.

Although overall learner conservation outcomes were relatively strong, some dimensions recorded lower scores than others, particularly those related to community participation and the relationship between conservation and climate change. This finding is noteworthy because contemporary conservation education increasingly emphasizes community engagement and climate literacy as integral components of conservation competence (Sutherland, 2017; Kamaludin et al., 2021; Imran et al., 2024). The literature suggests that conservation challenges are inherently social and require collaboration among schools, families, communities, government agencies, and other stakeholders (Jokilehto, 2007; Kobori, 2009; Imran et al., 2024). Similarly, growing recognition of the interdependence between biodiversity conservation and climate resilience has led to increasing integration of climate education within conservation programmes. The relatively lower scores observed in these areas therefore point to important opportunities for strengthening future conservation education interventions.

The assessment of conservation club strength revealed that weaknesses remained in the availability of conservation education materials, continuity and documentation systems, outreach activities, and teacher capacity in conservation education. These findings correspond closely with attributes identified in the literature as critical determinants of club effectiveness. Roberts (2009) highlights the importance of educational resources, organizational systems, and institutional support, while Yildirim and Akar (2021) and Park and Kim (2020) emphasize the importance of sustained programming, innovation, mentorship, and leadership development. The present findings therefore reinforce the proposition that conservation clubs function as organizational systems whose effectiveness depends on multiple interacting components rather than a single activity or intervention.

The findings further emphasize the importance of teacher mentorship and institutional support as enabling conditions for effective conservation education. Schools demonstrating stronger conservation

outcomes tended to benefit from active teacher involvement and institutional commitment to conservation activities. Conversely, where conservation activities depended primarily on a few highly committed individuals, implementation appeared less sustainable. These observations align with Roberts (2009), Yildirim and Akar (2021), and Park and Kim (2020), who identify teacher leadership, mentorship, programme coordination, and organizational support as fundamental determinants of successful environmental clubs.

Community engagement also emerged as an important factor associated with stronger conservation outcomes. Schools with more vibrant conservation programmes frequently extended conservation activities beyond school boundaries through outreach initiatives and engagement with surrounding communities. This finding supports earlier studies emphasizing that conservation competence is strengthened through participation in wider social and community processes (Kobori, 2009; Huy & Sharma, 2017; Jokilehto, 2007; Imran et al., 2024). It also reinforces the argument that environmental learning becomes more meaningful when learners are able to apply conservation knowledge in authentic social contexts.

A central finding of the study was the statistically significant positive relationship between School-Based Conservation Club Strength and Learner Conservation Understanding and Engagement. Schools with stronger conservation clubs tended to report higher learner conservation outcomes than schools with weaker clubs. This finding provides empirical support for the study's conceptual framework, which proposed that stronger clubs create more favourable environments for conservation learning through effective leadership, organizational capacity, educational resources, partnerships, mentorship, innovation, and learner participation. The positive regression coefficient suggests that improvements in these dimensions are associated with corresponding improvements in learner conservation understanding and engagement. The finding is consistent with previous studies demonstrating that well-functioning environmental clubs contribute to environmental learning, leadership development, environmental responsibility, environmental action competence, and pro-environmental behaviour (Roberts, 2009; Zhang et al., 2017; Zhang, Zhao, & Chen, 2019; Yildirim & Akar, 2021; Park & Kim, 2020). Collectively, these studies suggest that environmental clubs provide important institutional contexts through which conservation knowledge is transformed into meaningful environmental engagement and action.

The observed relationship is notable because it extends existing literature beyond examinations of individual club activities or isolated learner outcomes. Previous studies have typically focused on specific dimensions of conservation education, including environmental knowledge, attitudes, behaviours, leadership, stewardship, and participation (Kobori, 2009; Roberts, 2009; Zhang, Zhao, & Chen, 2019; Park & Kim, 2020; Huoponen, 2024). Similarly, assessments of environmental and conservation clubs have often emphasized particular organizational characteristics rather than evaluating club effectiveness as an integrated construct. By conceptualizing Conservation Club Strength as a multidimensional organizational capacity construct and Learner Conservation Understanding and Engagement as a multidimensional measure of conservation competence, this study demonstrates the

value of integrated approaches to assessing conservation education processes and outcomes. The significant relationship between these constructs suggests that organizational capacity within schools plays an important role in shaping learner conservation outcomes. More broadly, the findings indicate that conservation club effectiveness may be understood as an organizational capacity through which conservation learning and engagement are fostered.

Despite the statistical significance of the relationship, conservation club strength explained only a modest proportion of the variation in learner conservation understanding and engagement, with an effect size that falls within Cohen's (1988) classification of a small effect. This finding suggests that conservation clubs represent an important, but not exclusive, determinant of conservation learning. While previous studies have demonstrated positive educational benefits associated with environmental club participation (Roberts, 2009; Zhang et al., 2017; Zhang, Zhao, & Chen, 2019; Yildirim & Akar, 2021), the present findings indicate that conservation competence is shaped by a wider constellation of influences operating within schools, households, communities, and broader social environments. These may include classroom instruction, parental support, school leadership, community conservation initiatives, access to environmental information, and socioeconomic conditions. The modest effect size therefore highlights the complexity of conservation learning and reinforces contemporary perspectives that view conservation education outcomes as products of interconnected educational, social, and environmental systems rather than the influence of any single intervention (Sutherland, 2017; Imran et al., 2024).

An important contribution of the present study lies in its response to the measurement gaps identified in the literature. The review revealed that learner conservation outcomes have frequently been measured through separate indicators of knowledge, attitudes, behaviours, environmental responsibility, participation, or stewardship, with limited integration across these dimensions. Likewise, assessments of conservation clubs have commonly focused on selected aspects such as membership, activities, resources, or leadership structures without capturing overall organizational capacity. Consequently, the literature has lacked integrated frameworks capable of simultaneously assessing learner conservation competence and conservation club effectiveness in a comprehensive manner. By developing and applying the Learner Conservation Understanding and Engagement (LCUE) score and a multidimensional School-Based Conservation Club Strength framework, the present study addresses these measurement gaps and demonstrates the utility of integrated assessment approaches. The findings suggest that multidimensional frameworks provide a more holistic understanding of conservation education outcomes and the institutional conditions that support them, thereby contributing both conceptual and methodological advances to conservation education research.

Several limitations should be acknowledged. First, the cross-sectional design limits causal inference regarding the relationship between conservation club strength and learner conservation outcomes. Second, the study focused on schools within the Tsavo Landscape and therefore the findings may not be fully generalizable to all Kenyan schools. Third, although the LCUE and Club Strength frameworks demonstrated acceptable reliability, further validation across different ecological and educational

contexts would strengthen their external validity. These limitations notwithstanding, the study provides important empirical evidence regarding school-based conservation education in Kenya.

The findings also point to several directions for future research. First, given that conservation club strength explained only a modest proportion of the variation in learner conservation understanding and engagement, future studies should examine additional factors that may influence conservation learning outcomes, including classroom instruction, school leadership, parental support, community conservation initiatives, and socioeconomic conditions. Second, longitudinal research would be valuable for examining how learner conservation competencies develop over time and whether conservation club participation generates sustained behavioural outcomes beyond primary school. Third, the multidimensional LCUE and Conservation Club Strength frameworks developed in this study should be validated in other educational and ecological contexts to assess their broader applicability and robustness. Finally, future research could employ multilevel or mixed-methods designs to better understand how interactions among school-, community-, and learner-level factors shape conservation education outcomes.

Overall, the findings indicate that school-based conservation clubs constitute valuable platforms for promoting conservation education within primary schools. Stronger clubs are associated with higher levels of learner conservation understanding and engagement, particularly where conservation activities are institutionalized within school systems, supported by effective teacher mentorship, reinforced through learner ownership and leadership, and strengthened through experiential learning and community engagement. At the same time, the modest effect size and variations observed across schools suggest that improvements in conservation education require attention not only to club functionality but also to the broader educational and social environments within which conservation learning occurs. Strengthening club capacity, enhancing teacher support, promoting learner leadership, expanding community participation, and integrating climate-responsive approaches may therefore offer important opportunities for improving conservation education outcomes in schools.

Conclusion

This study examined the relationship between School-Based Conservation Club Strength and Learner Conservation Understanding and Engagement in Kenyan primary schools. The findings indicate that conservation clubs provide important platforms for environmental learning and that schools with stronger clubs tend to achieve higher levels of learner conservation understanding and engagement. Considerable variation was observed in both club strength and learner outcomes across schools, suggesting that effective conservation education depends not only on the existence of conservation clubs but also on the extent to which conservation activities are institutionalized within school systems, supported by teachers and school leadership, reinforced through learner participation and ownership, and implemented through practical and experiential approaches.

Beyond establishing a significant relationship between Conservation Club Strength and learner conservation outcomes, the study contributes to conservation education research by addressing important measurement gaps identified in the literature. Through the development and application of the Learner Conservation Understanding and Engagement Score (LCUE) and a multidimensional Conservation Club Strength framework, the study demonstrates the value of integrated approaches for assessing both conservation education outcomes and the organizational conditions that support them. Although club strength accounted for a modest proportion of the variation in learner outcomes, the findings affirm that well-functioning conservation clubs constitute a meaningful component of school-based conservation education. More broadly, the results suggest that conservation club effectiveness may be understood as a form of organizational capacity through which conservation learning and engagement are fostered. Strengthening club capacity, learner leadership, teacher mentorship, community engagement, and climate-responsive conservation practices may therefore enhance the contribution of schools to developing environmentally responsible citizens with the knowledge, skills, and dispositions needed to support sustainable environmental stewardship. The multidimensional frameworks developed in this study also provide a potentially useful foundation for evaluating conservation education programmes across diverse educational and ecological contexts.

Declarations

Author Contribution

Reviewed the draft and made suggestions for improvement. Was in charge of the database and the enumerators

Acknowledgement

I acknowledge the team of 12 enumerators whom I deployed to the field for about 16 days. I also acknowledge the contribution of Dr. Thomas Ombati, The Chairman, Department of Management Sciences and Project Planning, University of Nairobi who helped review the article as a peer.

Data Availability

Most supporting data are in the manuscript and where further data are required, I am able to provide upon request.

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Figures

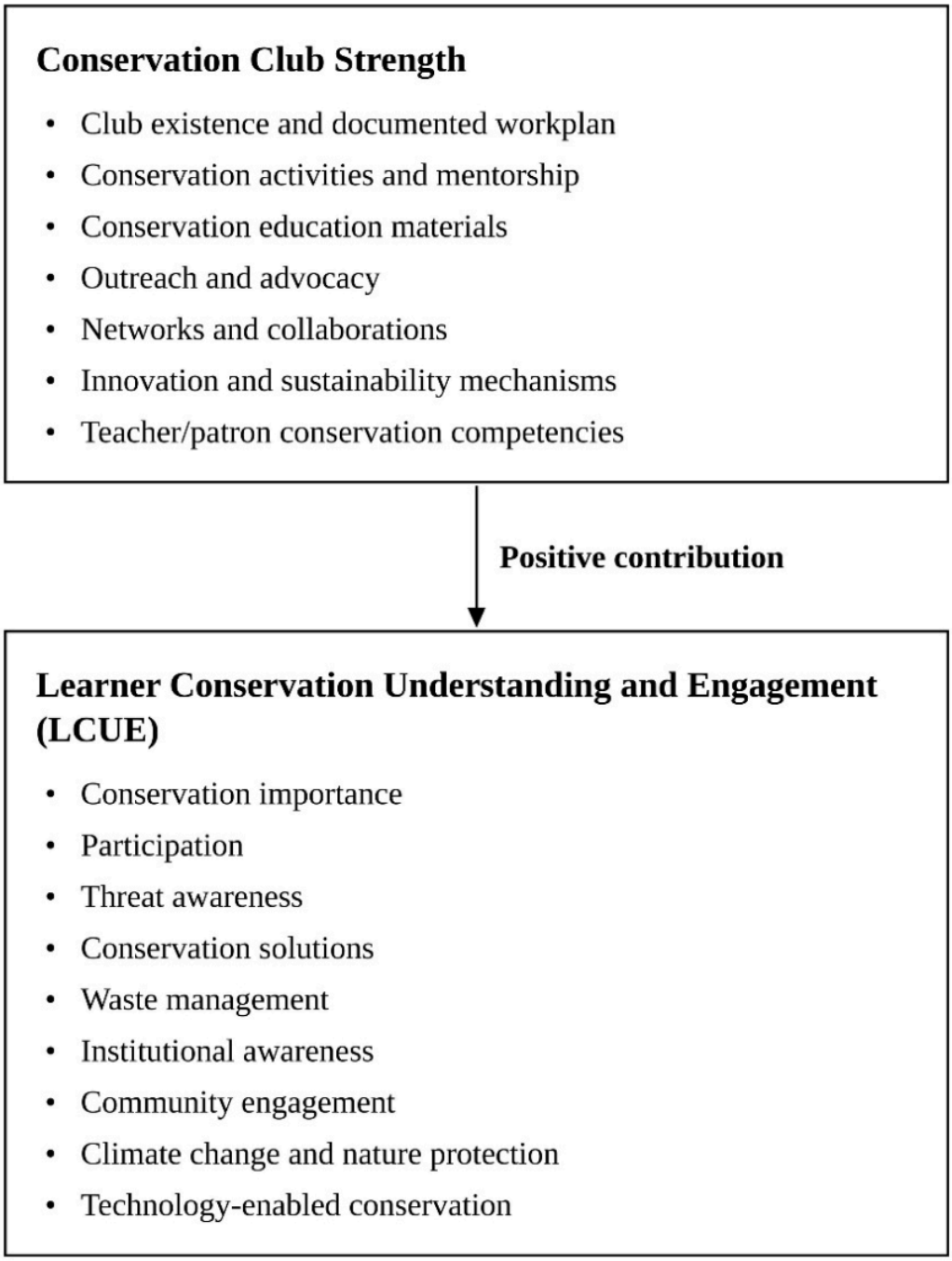

Figure 1: Conceptual Framework for the Study

Figure 1

See image above for figure legend.