Gender Differences in Environmental Sustainability Attitudes among Pre-Service Science Teachers in Selected Teacher Training Colleges in Tanzania

Edgar Fidel Nderego
Department of Curriculum and Instruction
The Open University of Tanzania
needgarn@gmail.com
https://orcid.org/0000-0001-6347-8915

Abstract
This study aimed to assess gender differences in sustainability attitudes among pre-service teachers in Tanzania. A total of 926 pre-service science teachers (486 males and 440 females) from five teacher training colleges participated in the study. Data were collected using a questionnaire which essentially measured the participants' sustainability attitudes. Descriptive statistics (mean and standard deviation) and an independent sample t-test were employed to analyze the data. The results revealed that pre-service teachers generally exhibited positive sustainability attitudes, with an average mean score of 3.96. However, no significant gender differences between male and female pre-service teachers were found in sustainability attitudes ($t(924) = 1.455$, $p = 0.146$). The study recommends educational institutions prioritize on innovative pedagogical approaches that instill environmental responsibility to all students. Future research should explore other factors beyond gender that may affect sustainability attitudes.

Keywords: *Gender Differences, Sustainability attitudes, Pre-service teachers, and Teacher Training Colleges*

INTRODUCTION AND BACKGROUND

Environmental Sustainability has become a critical global concern due to increasing challenges posed by climate change, resource depletion, and environmental degradation (UNESCO, 2018; MoEVT, 2010). For example, globally the population of wild vertebrate species has fallen by an average of nearly one third (31%), and fresh water ecosystems has declined to 41% from 1970 to 2006 (Convention on Biological Diversity, 2010). In Tanzania, at least one-third of its important ecosystems has been

lost in the last few decades (URT, 2015). Land degradation has increased from 42% in 1980 to almost 50% in 2012 (URT, 2014).

To address the environmental challenges, the Government of Tanzania introduced the Environmental Education Strategy (EES) in 2010 (URT, 2010). This strategy aimed to integrate environmental sustainability into the education system by revising teaching, learning, and assessment approaches in basic education and pre-service teacher education. The primary focus was on fostering lifelong learning skills and equips learners with the knowledge, attitudes, and values necessary to promote sustainable environmental practices (MoEVT, 2010). By recognizing the need for further refinement, in 2015, the same government developed additional guidelines which advocated for participatory and inclusive pedagogical approaches in Environmental Education (EE) and Education for Sustainable Development (ESD) (URT, 2015).

These approaches emphasize interdisciplinarity, learner-centred education delivery, collaboration, and a transformative, pluralistic perspective. To achieve these outcomes, curriculum reforms in teacher education, such as those implemented in 2003 and 2009, embedded environmental education content across various subjects including Biology, Geography, Physics, and Agriculture (MoEVT, 2010). These comprehensive initiatives were designed to change learners' behavior and attitudes towards environmental conservation and sustainability. According to Gifford and Nilsson (2014), early exposure to nature and environmental education significantly impacts on pro-environmental attitudes and behaviours later in life. Knowledge and education enhance awareness and understanding of environmental issues. This provides opportunities for individuals to adopt sustainable practices. Uitto, Boeve-de Pauw andSaloranta (2015) assert that sustainability experiences obtained in schools should influence sustainability-related attitudes, values, and self-efficacy beliefs of the graduates outside the schools. These influence their behaviours and the behaviours of other community members.

Despite deliberate efforts to integrate environmental sustainability issues into pre-service teacher education programs, evidence shows that sustainability issues are still challenging. The disconnection between lifestyles and daily actions of teachers who have completed teacher education programmes exist across different settings (URT, 2015). One of the factors which contribute to this issue is the absence of strong pro-

environmental attitudes among teachers and pre-service teachers. Without a strong pro-environmental mindset, the knowledge and skills acquired in pre-service teacher education programs often become ineffective.

According to Gifford and Nilson (2014), environmental attitudes are shaped by complex interactions between personal values, social norms, cultural contexts, and external factors like education and policy frameworks. The personal factors include childhood experience, knowledge and education, personality and self-construal, as well as sense of control, values, political and world views (Gifford & Nilson, 2014). Others are goals, felt responsibility, cognitive biases, place attachment, age, gender, and chosen activities. The social factors include religion, urban-rural differences, norms, social class, proximity to problematic environmental sites, and cultural and ethnic variations.

Even though multiple factors influence environmental sustainability attitude, this study placed attention to gender. Gender plays a crucial role in shaping and reshaping sustainability practices and influences how individuals perceive, prioritize, and respond to environmental issues (Fremerey& Bogner, 2015; Sutton & Gyuris, 2015; Bergman, 2016; Ezpeleta & Sanz, 2020). Research conducted in various countries, including the USA (Plavsic, 2013; Levine & Strube, 2012; Cifuentes-Faura, et al, 2020; Briscoe et al, 2019), China (Wang & Li, 2020; Chen et al, 2021), Taiwan (Tien & Huang, 2022), South Africa (Synodinos, 2016), and Kenya (Njeru, 2020), consistently highlights that men and women exhibit distinct attitudes and behaviours toward environmental conservation. A common finding across these studies is that women generally demonstrate greater concern for sustainability and engage more actively in pro-environmental behaviors than men. However, while gender differences in sustainability attitudes appear to be a global trend, variations may exist across diverse cultural, economic, and educational contexts.

The study at hand anticipated that the universality around pro-environmental attitudes in terms of gender may not be applicable across all regions. Therefore, this study explored the extent to which gender differences are manifested between and among pre-service teachers in Tanzania. Most studies in the country have focused on discipline-bound differences and sustainability integration into secondary and primary school settings (Mwendwa, 2018; Kimaro, 2018; Kimaryo, 2011). The

study tested one hypothesis:There are significant gender differences in environmental sustainability attitudes among pre-service teachers.

Theoretical Framework

The study adopted Gender Role Socialization Theory developed by Sandra Bem in 1993. The theory explains how individuals learn and internalize gender specific expectations, behaviours, and attitudes in their own environment. This process begins in early childhood and continues to be shaped by family, education, peers, media, and culture. Over time, these agents of socialization influence how men and women perceive their societal roles, responsibilities, and attitudes towards environmental sustainability. According to the theory, women are traditionally socialized to be caregivers and nurturers. This often leads them to develop a greater sense of responsibility for nature and sustainability. Thus, women are more likely to be the primary household managers, making them more attuned to issues related to resource conservation, waste management, and environmental protection (Xiao and McCright 2015; Vicente-Molina,et al., 2018).

In contrast, men are often socialized to value individualism, competition, and resource exploitation, which may lead to less immediate concern for sustainability issues (Evans, 2024). Traditional masculinity norms emphasize technical problem-solving and economic productivity. This can make men prioritize industrial growth and technological solutions over conservation. In some cases, men may also perceive environmentalism as incompatible with their gender identity, resulting in lower engagement with pro-environmental behaviours (Evans, 2024).

Understanding gender differences in sustainability attitudes is essential for developing gender-responsive teacher education programs that encourage engagement in multiple perspectives. By doing so, college pre-service teacher education can foster a balanced and holistic approach to sustainability. This ensures that both male and female pre-service teachers are equipped with the necessary knowledge and skills to enhance environmental sustainability in their future teaching practices. In other words, gender-sensitive approach ensures that both male and female educators are empowered to become active agents of change. This promotes sustainable practices that resonate with all learners regardless of gender.

METHODOLOGY

Participants

This study involved pre-service science teachers from five teacher colleges in Tanzania which enrolled and produced a large number of diploma science teachers. Science related pre-service teachers were specifically chosen because their subject areas of specialization contain a substantial amount of environmental sustainability content compared to social science and humanities subjects. Moreover, all pre-service teacher colleges follow a national curriculum. This ensures consistency in their preparation and training they receive. Only the final year student teachers were selected as they were assumed to have developed sufficient knowledge and skills around environmental education content and teaching methodologies.

The number of pre-service science teachers across five teacher colleges was 2,057. From this population, around 926 student teachers (i.e., 486 males and 440 females) were sampled. This formula was used to obtain the sample: n = [z2 * p(1-p)] / e2 / 1 + [z2 * p(1-p)] / e2 * N]. In this light, **n**is the sample size, **P** is population proportion or the standard deviation (assumed as 50% or 0.5), **Z** is the z-score which was determined based on the confidence level of 95%, **e** is the margin of error or confidence interval (in this study 5% of margin error/confidence interval was used), **N** is the population.

Procedures

The researcher conducted visits to five teacher colleges. During these visits, the researcher first met with the college principals to provide them the introductory letter. The letter explained the purpose of the study and how it would be conducted. Once the principals agreed, I scheduled the meeting with all second-year pre-service science teachers. These students were provided with consent forms to complete. They were clearly informed that their participation in the study was entirely voluntary and thus, they could withdraw at any time.

Instrument

Questionnaires adopted from Gericke et al (2019) were primary data collection instrument. This instrument has previously been tested and validated to ensure its reliability in relation to assessing environmental sustainability attitudes. The questionnaire consisted of fourteen (14) items each rated on a five-point Likert scale ranging from 1 (Strongly Disagree)

to 5 (Strongly Agree). These items were grouped into three dimensions to comprehensively assess the different aspects of sustainability attitudes as follows:

1. **Environmental Dimension:** This included six items assessing participants' attitudes toward environmental sustainability. These items evaluated their views regarding protecting ecosystems, conserving resources, and addressing climate change. The statements included: (1) using more natural resources than necessary does not threaten future well-being, (2) the need for stricter environmental protection laws, and (3) taking measures against climate change-related problems.
2. **Social Dimension:** This consisted of four items: providing opportunities for sustainable living, ensuring future generations enjoy the same quality of life, and promoting equal educational and empowerment opportunities for both women and men. The statements included: (1) everyone should be given the opportunity to acquire knowledge and skills for sustainable living, (2) current generations should ensure that future generations enjoy the same quality of life, and (3) women and men must have equal opportunities for education and empowerment.
3. Economic dimension: This included four items focusing on participants' attitudes toward economic growth, resource allocation, and balancing economic progress with sustainability. These items examined the responsibility of companies in reducing waste, the importance of poverty reduction, and ensuring equal working conditions for employees in both poor and rich countries. The statements included: (1) companies should reduce packaging and disposable items, (2) reducing poverty is important, and (3) companies should provide equal conditions for employees in poor and rich nations.

The inclusion of these three dimensions (i.e., environmental, social, and economic provided a holistic understanding of participants' sustainability attitudes. This ensured that the multifaceted nature of sustainability, reflecting the interconnectedness of environmental, social, and economic factors were captured.

Instrument Reliability

In order to ensure reliability of the research instrument, the reliability analysis was conducted using Cronbach α (i.e., the most common

measure). Data obtained during pilot study was used for this purpose. The data generated from 24 participants who engaged in the pilot were analyzed statistically using SPSS 20 version for reliability test. The results are indicated in Table 1.

Table 1
Cronobach'sAlphafor sustainability attitudes

S/N	Dimensions of sustainability attitudes	Number of Items	Cronbach's α
1	Environmental dimension	6	0.66
2	Social dimension	4	0.79
3	Economic dimension	4	0.73

Source: Piloting Data 2023

DATA ANALYSIS PROCESS

The collected questionnaire responses were entered into SPSS software (version 20.0), and each item was numerically coded based on a five-point Likert scale to facilitate quantitative analysis. Specifically, responses were assigned values as follows: 1 "Strongly Disagree", 2 "Disagree", 3 "Neutral", 4 "Agree", and 5"Strongly Agree". This was followed by a normality test to determine whether the data were normally distributed or not. A normality test was performed using the Kolmogorov-Smirnov (K-S) Test and Shapiro-Wilk (S-W) Test to determine whether the data met the assumption of normal distribution. Descriptive statistics specifically mean and standard deviation (SD) were computed to summarize the sustainability attitude scores for both male and female participants. These descriptive statistics helped establish an initial understanding of gender differences in sustainability attitudes. Finally, inferential analysis using an independent sample t-test was undertaken to determine statistical significance about sustainability attitudes between and among pre-service science teachers.

Findings and Discussion

The findings of the study are presented starting with an assessment of the assumptions underlying the data analysis through a normality test followed by an examination of gender differences in environmental sustainability attitudes among pre-service teachers.

Normality Testing

To assess whether the data met the assumption of normality, both the Kolmogorov-Smirnov and Shapiro-Wilk tests were conducted. The results of these normality tests are presented in Table 2 below.

Table 2
Normality Tests for Sustainability Attitude

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
Variable	Statistics	df	p	Statistic	df	p
Sustainability attitude	.087	926	.049	.967	926	.054

Table 2 shows that the p-value for the Kolmogorov-Smirnov test is 0.049, which is less than 0.05, indicating that the data deviate from normality. However, the p-value for the Shapiro-Wilk test is 0.054, which is greater than 0.05, suggesting that the data do not significantly deviate from normality. Since the Shapiro-Wilk test is generally more reliable for a large sample, the data are considered approximately normally distributed which is suitable for parametric tests.

Gender Differences in Environmental Sustainability Attitudes among Pre-service Teachers

Descriptive statistics related to gender and attitudes toward environmental sustainability among pre-service teachers are presented in Table 3.

Table 3
Descriptive statistics on Gender Differences in Environmental Sustainability Attitudes

Participants	N	M	SD
Male	486	3.75	.557
Female	440	3.89	.589
Total	926		

The findings in table 3 indicate that female pre-service science teachers exhibited slightly higher sustainability attitude scores than their male counterparts. This difference, though modest, may indicate variations in environmental awareness, socialization, or educational engagement. The standard deviations (0.557 for males and 0.589 for females) suggest a relatively similar level of variability within each group. This means that attitudes toward sustainability are not drastically different among individuals of the same gender. However, these descriptive results alone do not confirm whether or not the observed difference is statistically significant. For this reason, an independent sample t-test is necessary to determine the mean scores. This is crucially important because of random variation which reflects a genuine gender-based disparity in sustainability attitudes.

Independent Sample T-Test

Since the data were approximately normally distributed, an independent samples t-test was performed to compare the mean sustainability attitude scores between male and female pre-service teachers. The t-test results were interpreted based on the t-statistic and p-value, with a significance level set at 0.05. This helped to determine the extent to which gender differences in sustainability attitudes were statistically significant. Table 4 below presents the results of the independent samples t-test.

Table 4
Independent sample t-test of gender differences on sustainability attitude

	t	df	Sig. (2-tailed)
Gender	1.455	924	.146

p>0.05 level. On two tail test

The t-test results, t (924) = 1.455, p = 0.146, presented in Table 4, indicate that there is no statistical substantial difference in sustainability attitude scores between male and female pre-service science teachers at the 0.05 significance level. Male pre-service teachers had a mean score of 3.75 (SD = 0.557) and female pre-service teachers had a slightly higher mean score of 3.89 (SD = 0.589). This difference is not significant enough to conclude that gender plays a decisive role in shaping sustainability attitudes. The implication here is that shared educational experiences, instructional strategies, and curriculum exposure have a stronger influence on sustainability attitudes than gender differences.

Research indicates that when pre-service teachers receive the same curriculum content, teaching methodologies, and learning opportunities, gender-based differences in attitudes tend to diminish significantly (UNESCO, 2017; Tuncer et al., 2009). Kollmuss and Agyeman (2002) argue that sustainability attitudes are primarily shaped by curriculum design, pedagogical approaches, and engagement in environmental issues rather than gender alone. As earlier noted, both male and female pre-service science teachers in this study had opportunities for professional development related to sustainability concepts, discussions, and practical activities. This could be one of the contributing factors to their comparable attitudes. Evidence indicates that socialization, cultural norms, and prior environmental experiences have a greater impact on shaping sustainability attitudes than gender itself (Schultz et al., 2005).

Findings align with previous research which indicate that gender differences in sustainability attitudes become less pronounced when both male and female pre-service teachers receive equal environmental education (Olsson et al., 2016). This highlights the importance of high-quality sustainability education in fostering positive attitudes among future educators. Burmeister and Eiks (2013) and Marcos-Merino et al. (2020) found that pre-service teachers develop stronger sustainability attitudes when they participate in sustainability-focused education programs. This supports the view that sustainability attitudes are not significantly influenced by gender (Larson et al, 2010; Castleberry & Green, 2010; Levine & Strube, 2012; Liefländer& Bogner, 2014). The results at hand suggest that well-designed teacher training programs can effectively foster sustainability attitudes acrossgender and subsequently reinforce the universal nature of sustainability education.

CONCLUSION AND RECOMMENDATIONS

These findings underscore the transformative power of education in shaping sustainability attitudes. In other words, the well-designed teacher training programs can cultivate pro-environmental mindsets across gender. Rather than being an inherent trait, sustainability attitudes are a reflection of curriculum quality, instructional strategies, and meaningful engagement with environmental issues (Tomas et al., 2017; Misseyanni, 2020). The integration sustainability education into teacher preparation is crucial in ensuring that all future educators are equipped with the knowledge, skills, and motivation to foster environmental responsibility in their students. By embedding sustainability principles into pedagogy, institutions can create a ripple effect that extends beyond individual teachers to influence entire generations of learners. A commitment to high-quality sustainability education will not only strengthen environmental literacy among pre-service teachers but also empower them to become agents of change in their communities. Therefore, the focus should shift from demographic factors to the broader goal of enhancing sustainability education beyond gender.

Educational institutions must prioritize on innovative pedagogical approaches that instill environmental responsibility in all students. This involves integrating active learning strategies, problem-based learning, and interactive discussions into classroom teaching practices. This not only enhances engagement but also reinforce positive attitudes toward environmental stewardship. Future research should go beyond existing

frameworks to examine the influence of other demographic information on sustainability attitudes. These include cultural background, prior environmental education experiences, and socio-economic status. A mixed methods research approaches that incorporate qualitative and quantitative data will provide a deeper and more comprehensive understanding of the phenomena at hand.

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