



Environmental Literacy in Teachers' Training: Cognitive Elements and Environmental Behaviour of Prospective Student-Teachers

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Abstract: *This study examined the level of environmental literacy among prospective student-teachers in the field of adult education and community development offered by the Institute of Adult Education in Tanzania. The randomly selected sample of 111 prospective student teachers admitted to the Diploma of Adult Education and Community Development (DAECD) was assessed using a questionnaire designed to measure environmental knowledge (cognitive) on national together with global issues and priorities, health and environment, water, ecology as well as environmental behaviours. Findings indicated that prospective student teachers were knowledgeable of basic facts about the environment and possessed some responsible behaviours including discipline of protecting and serving the environment. However, they have limited information on global issues such as pollution, loss of biodiversity and climate change. Results from this study emphasize the need to instil environmental literacy in students who choose to study as educators. Teacher training programmes should consider characteristics of the student population, which are outcomes from their individual knowledge, attitudes as well as behavioural elements and include all necessary components for adequately preparing educators who are effectively involved in building environmental competences of their future students.*

Key words: *Environmental literacy, environmental education, teachers' training, cognitive elements, environmental behaviour.*

Introduction

Tanzania is among developing countries with 63.343 million people (NBS, 2022) and remarkable economic growth in recent years, with an average annual national Gross Domestic Product (GDP) increase of nearly 6 percent, making it one of Africa's fastest-growing economies (Ndilito & Massito, 2023). Such tremendous

achievement sits alongside agricultural, industrial and infrastructure growth and innovation. Tanzania's natural environment supports most of such achievements by supplying enough food, minerals, tourist sites and other resources needed to produce goods and services and absorbing industrial by-products in the form of pollution and waste. However, the current state of its environment is a matter of concern due to land degradation, deforestation, pollution, loss of wildlife habitats and biodiversity as well as lack of accessible good quality water for both urban and rural inhabitants (NBS, 2022; URT, 1997).

Since the Tanzanian environment is constantly changing in strains, the nation has emphasized that the management of the environment should be everybody's responsibility. According to the country's environmental policy of 1997, every citizen has the opportunity to make environmentally responsible choices that can minimize their impacts on the environment and promote sustainable development (URT, 1997). On this basis, a significant level of environmental literacy is critical to attain the country's development plans. Country environmental literacy acts as a lever of social change and a practical tool for empowering each pillar of sustainable development, namely, economic, and social development and environmental protection (Oghenekohwo & Frank-Oputu, 2017). Beyond understanding simple facts, environmental literacy provides an individual's ability to make environmentally sound decisions and take appropriate action(s). To be environmentally literate, sound knowledge of threats to the environment is essential (Loubser & Swanepoel, 2001).

Again, the pursuit of safeguarding the environment in Tanzania is retrogressing as the adult literacy trend was estimated to go down to 77 percent in 2015 compared to the situation in the 1970s when the rate was around 90 percent and was among the highest in the world (UIS, 2013). The country's adult literacy growth has been slow, inconsistent, and characterized by regional gaps (Fute, *et al*, 2022). However, the country's literacy levels were estimated to increase towards the end of 2020s as the government made primary education compulsory and fee-free, which increased access and participation at this level of education (Mashala, 2019; Shukia, 2020). Based on these facts, it is easy to assume that a significant percentage of the population is likely not to be aware of environmental issues and a great majority does not have a sound educational background or clear understanding of issues hammering the environment or affecting them. For example, over the past four years, the agricultural sector has grown by an annual average of 5.1 percent, provides 65 percent of total employment and accounts for 27.7 percent of GDP,

24.1 percent to exports earnings and 65 percent of inputs to the growing industrial sector (URT, 2021). In Tanzania, small-family farmers, most are poor with little knowledge, dominate the agricultural sector, accounting for approximately 75% of the total agricultural output (Machimu, 2023). Thus, with such a share in economic growth and the country's illiteracy level, there is a possibility that this sector to cause changes in the hydrologic cycle; emit toxic chemicals and pathogens; reduce or alternate wildlife habitats; as well as emerging invasive species if appropriate measures would not be taken (USGS, 2007).

The first UN Conference on the Human and Environment held in Stockholm in 1972 stimulated focus on “education in environmental matters” by laying down a principle that broadens the basis for enlightening opinion and having responsible conduct by individuals, enterprises, and communities in protecting and improving the environment in its full human dimension (Momtaz, 1996). Twenty years later, Agenda 21 of the Rio Declaration on Environment and Development of 1992 states that “human beings are the centre of concerns for sustainable development, they are entitled to a healthy and productive life in harmony with nature” (Krishnamoorthy, 2005). It emphasizes that people are inseparable from the environment in which they live and may be affected when things go wrong in environments. Through such considerations and other follow-up conference agreements including 17 Sustainable Development Goals established by the United Nations in September 2015, the need for environmental education becomes crucial factor in national development efforts.

Environmental literacy is similar to environmental education. Both have a scope of exposing students to environmental concerns and sustainability practices as well as providing sound general learning opportunities. Environmental education aims to nurture skills in exploring environmental issues, engaging in problem-solving, and taking action to improve the environment and eventually, individuals develop a deeper understanding of environmental issues and have skills to make informed and responsible decisions (US-EPA, 2015). In this way, the communities are empowered with ethics that can take part in the wise use of natural resources and good management of the environment (Loubser & Swanepoel, 2001).

Gopal and Anand (n.d.) referred to the curriculum of environmental education as the sum of learning experiences that can be thought to comprise three linked components: education about environments (knowledge); education for the environment (values, attitudes, and positive actions); and education through the environment (resources). The curriculum, therefore, should offer life experiences

and aspirations of people and the nation on enhancing knowledge, attitude, motivation, commitment, and skills in finding a solution to current problems and preventing new ones. Accordingly, the curriculum should aim to build appropriate environmental behaviours. Individuals' environmental behaviours reflect their environmental literacy. Consequently, environmental literacy should develop appropriate environmental behaviours (Pe'er *et al.*, 2007). The suggested way to develop environmental behaviour is through a progression from environmental knowledge (cognitive) to environmental awareness and concern (environmental attitudes), which, in turn, lead to the attainment of environmental behaviours (Lee *et al.*, 2005). Various literature sources provide several approaches that constitute the relationship between cognitive components, affective (attitudes) components, and environmental behaviour (Lee *et al.*, 2005; Negev *et al.*, 2008; Pe'er *et al.*, 2007; Pooley & O'Connor, 2000).

In regard to this study, the construct of cognitive performance dealt with respondents' ability to recognize many of the basic terms used in communicating about the environment and to provide rough, if unsophisticated, working definitions of their meanings (Loubser & Swanepoel, 2001; Yilmaz 2021). The construct of behaviour performance refers to the operational level of respondents on demonstrating an ongoing sense of investment and responsibility for preventing or remediating environmental degradation, both personally and collectively and are likely to be acting at several levels from local to global in so doing (Loubser & Swanepoel, 2001).

Student-teachers are expected to be individuals who are sensitive towards environmental protection and conservation with assumption rests in the prime understanding that a society with high environmental awareness is only possible through teachers who have a high environmental awareness (Ozonur, 2021). This study aimed to examine the environmental literacy level of prospective student-teachers aiming to enrol into further educational training in Tanzania. Emphasizing prospective students was taken to set a benchmark of an initial ability test to determine the predictions of student competence on environmental literacy after being accepted at a tertiary institution with a particular major or study programme. Through this way, it may be possible to gain insights into the previous knowledge students held and the way the underlying ideas are understood and develop teaching strategies which maximise their meaningful learning (Hassan, 2003).

A group of primary school teachers who were about to enrol on the Diploma in Adult Education and Community Development (DAECD) offered by the Institute

of Adult Education (IAE), represented the sample of the study. Specifically, the study focused on demonstrating the cognitive-level and environmental behaviour of these student-teachers. The DAECD programme is designed to equip learners with competences on how to facilitate and manage adult education including community development programmes. The programme also helps learners to be active agents of change toward safeguarding the environment.

Methodology

The study involved a heterogeneous group 126 of prospective student-teachers expected to be admitted into the Diploma in Adult Education and Community Development (DAECD) in the year 2020/2021. A total of 111 surveys were returned for a response rate of 88%. The DAECD is an open and distance learning programme under the Institute of Adult Education in Tanzania. The sampled student-teachers were randomly selected during orientation sessions of the admitted students from Dar es Salaam City Municipal and Mbinga District in Ruvuma region to represent students with backgrounds in urban and rural areas. The data were collected using adapted and modified instruments featured in a Nationwide Survey of Evaluating Environmental Literacy of Undergraduate Students (Liang *et al.*, 2018). The instrument, which is a questionnaire, focused the measurement on terms of reflecting appropriate environmental knowledge (cognitive) on national and global issues and priorities, health and environment, water, ecology as well as environmental behaviours.

The questionnaire had 18 and 19 cognitive and behavioural questions, respectively. Also, it had an additional question on individual preference in choosing mode of transportation. Student-teachers were assessed about their levels of cognition and extent of behaving environmentally by choosing correct answers from given multiple choices. Data collected for this study were analysed quantitatively. Descriptive statistics was applied to produce frequency distribution tables, averages, standard deviations as well as inferential statistics. Inferential analyses were done by computing the pairwise correlation between cognitive and behaviour performance. Before examining any differences, the questionnaires were marked to develop performed scores.

Also, the comparison was made regarding variability. This was done by using the coefficient of variation (C.V), which was computed by taking the standard deviation divided by the mean. The item or group with a smaller C.V. is said to be more stable, more consistent, less variable, and more homogeneous than others. Data were analysed using IBM SPSS version 28 for descriptive statistics after

marking the questionnaires to develop performed scores. The results are reported in aggregate form in the following section.

Results

General Descriptive Findings on Cognitive Element

The findings from Table 1 indicate that the majority (97.3%) of the respondents know the basic meaning of the environment, understand most polluted cities, and know the causes of killer diseases like dengue and bilharzia. About 64% of participants knew types of friendly ways of power generation, 74.8% knew the causes of soil erosion and 60.4% were familiar with historical and major attractive sites like Olduvai Gorge. However, some of them (<50%) had the least knowledge of causes of pollution, biodiversity, climate change, renewable energy, and geographical features.

Table 1. Cognitive Elements Towards Environment

Cognitive Elements	Frequency out of 111	Percentage
Environment is everything surrounding us	108	97.3
Excessive burning of coal, oil, and fossil fuels does not lead to ozone depletion	8	7.2
The most environmentally friendly type of power generation is solar energy	71	64.0
Deforestation causes soil erosion	83	74.8
Olduvai Gorge is found in Arusha, Tanzania	67	60.4
Serengeti is the biggest Tanzanian National Park	83	74.8
Dar es Salaam is the most air polluted city in Tanzania	104	93.7
A dense floated plant species in rivers cannot help the ecological balance of the river systems	33	29.7
Carbon dioxide is a greenhouse gas found on Earth in large quantity	23	20.7
Plants are the source of renewable Energy	36	32.4
Oxygen gas supports combustion/burning	65	58.6
Mercury is the major source of water pollution in gold mines owned by small miners in Tanzania	30	27.0
The disease bilharzias is caused by snails	98	88.3
Dengue fever is caused by mosquitoes	100	90.1
Sao Hill forest reserve is found in Iringa region, Tanzania	41	36.9
Lake Victoria is not found in East African rift valley	45	40.5
Lake Tanganyika is the deepest lake in Africa	78	70.3
In an ecosystem, bacteria are the decomposers	26	23.4

General Descriptive Findings on Behavioural Element

Table 2 indicates that participants demonstrated positive behavioural elements toward the environment by scoring more than 70 percent of the total behavioural score. It means they are willing to participate in environmental events, use multi-media to obtain information related to environmental issues and advise solutions to be taken, integrate different viewpoints on environmental issues and reflect on impacts, know appropriate channels, and communicate relevant environmental-related information to others. Also, they indicated to be knowledgeable that they are responsible for solving any environmental problems caused by themselves, they

have a duty to prevent environmental pollution incidents caused by other people as well as they influence people around them to have better awareness of environmental protection. However, 61.3% of them used to sort out varieties of recyclable items by using different recyclable methods, while 68.5% could observe terrain/landscape to determine if a place could be flooded or not. Minority of the participants (48.6%) indicated that they had participated in related rallies, marches, or petition activities on environmental policies or activities.

Table 2. Behavioural Elements Towards Environment

Behavioural elements	Frequency out of 111	Percentage
I am willing to participate in the environmental events (i.e., natural conservation, monitoring, and maintenance activities)	106	95.5
I used to sort out varieties of recyclable items.	68	61.3
I used different recycling methods.	68	61.3
I observe the terrain/landscape to determine if a place would be flooded or not.	76	68.5
I use multimedia, such as newspapers, magazines, or the Internet to obtain information related to environmental issues.	105	94.6
I used to identify environmental problems and find solutions to them.	101	91.0
Usually, I used to integrate different viewpoints on environmental issues and form my personal opinions.	86	77.5
I reflect on my own behaviour regarding the social and environmental impacts.	104	93.7
I communicate relevant environmental-related information to others.	101	91.0
I use appropriate channels to promote environmental knowledge and environmentally friendly policies or activities.	86	77.5
I use appropriate channels to appeal environmental complaint issues, to help avoid environmental pollution incident.	89	80.2
I always bring my own personal water bottle or use reusable utensils when I go out.	74	66.7
Normally I convey environmental protection information to my family members or friends.	99	89.2
I used to participate in environmental organizations on campus (i.e., green squad, green campus groups, etc.).	64	57.7
I had extracurricular experiences in environmental activities (i.e., beach cleaning, ecological pond cleaning, and other ecological activities).	77	69.4
I used to participate in environmental related rallies, marches, or petition activities, debates, or activities.	54	48.6
It is my responsibility to solve any environmental problems caused by myself.	104	93.7
It is my duty to prevent environmental pollution incidents caused by other people.	101	91.0
It is my responsibility to influence the people around me to have better awareness on environmental protection.	108	97.3

As indicated in Table 3 participants demonstrated average positive environmental behaviour of prioritizing walking and taking public transport while they go out.

Few of them (6%) opted for cycling. Their preferences, however, can be related to other considerations like budgeting, safety, urgency to reach destinations, availability, flexibility, reliability, and regularity of services. It is important to keep in mind that one's preferences are influenced by socio-economic development and community members' literacy on environmental benefits embedded in each mode of transportation.

Table 3. Behavioural Elements on Opting Mode of Transport

Behavioural elements	Frequency out of 111	Percentage
While I go out, I am willing to give priority on;		
Walking	48	43.2
Cycling	6	5.4
Taking public transportation	42	37.8
Other transportation modes	15	13.5
Total	111	100.0

Descriptive Statistics Between Cognitive and Behaviour Performance

Table 4 indicates that the average score for individual cognitive performance is smaller (55.86) than that for individual behaviour (88.89). It means the survey individuals have less knowledge of environmental-related issues than their positive behaviours on the environment. They are much more capable of observable behaviours and the impact of environmental stimuli than using their mental processes like memory, perception, and problem-solving, with emphasis on internal mental states.

The median for individual cognitive performance is 55.56 (Table 4). It means that half of the respondents scored above the median value and half scored below the median value. For individual behaviour, the median score is 88.89 (Table 4) and it means that more than half of respondents scored above the median value. Regarding variability, using the coefficient of variation (C.V), which is computed by taking standard deviation/mean, the analysis results are presented in Table 4. The C.V for individual cognitive performance is 21 percent and that of individual behaviour performance is 17 percent. The item or group with smaller C.V is said to be more stable, more consistent, less variable, and more homogeneous than others. Therefore, performance for individual behaviour is more consistent than that of cognitive performance. This shows that participants might have moderate knowledge of matters concerning the environment compared to their commitment they have in protecting and serving the environment.

Table 4. Descriptive Statistics Between Cognitive and Behaviour Performance

	Individual Cognitive Performance	Individual Behaviour Performance
Valid Counts	111	111
Mean	55.8565	84.2842
Median	55.5600	88.8900
Mode	55.56	88.89
Std. Deviation	11.69808	14.67712
Coefficient of variation	0.2094	0.1741
Skewness	0.016	-0.607
Range	55.55	72.23

Discussion

Possession of knowledge and positive behaviour towards the environment tend to enhance the development of environmental problem-solving skills among student-teachers who are pursuing practical solutions to various environmental problems. It is important for teachers to have a proficient level of environmental literacy because they are expected to play a crucial role in educating and sharpening the environmental perspectives of future generations (Loubser & Swanepoel, 2001; Ozonur, 2021). Most of the respondents (student-teachers) were employees from public primary schools who were motivated to join DAECD to nurture their education capacities. This study portrayed their understanding and knowledge about environmental issues, sustainability, and the interconnectedness between human activities and the environment.

Based on the findings from this study, most of the literacy scores of surveyed participants were within the nominal level of environmental literacy. At this level, they have the ability to recognize many basic terms used in communicating about the environment and provide simple meaning on surrounding issues. Also, they have acquired some of the values and feelings of concern for the environment and are motivated to actively participate in environmental improvement and protection. This level of environmental awareness places the student–teacher on the ability to demonstrate familiar activities and habits aimed at the maintenance of environmental quality. The findings regarding environmental literacy and dimensions in this study align with the outcomes of previous studies conducted by Yilmaz (2021) and Ozonur (2021). These studies similarly identified that the

overall awareness level of environmental issues among the prospective teachers was moderate to above average.

On the other hand, the findings indicated that participants had limited knowledge of environmental issues like pollution, loss of biodiversity, renewable energy, and climate change. This is evidenced through their attainment of minimum scores on questions related to greenhouse gas, pollution, renewable energy, and their understanding of biodiversity. These are interlinked global crises the world is facing today and most of the world's citizens are not fully aware of them. According to Summers et al. (2000), most teachers were not well understood or were absent in knowing and addressing these global environmental crises. Kira and Kafanabo (2016) also present a similar result from a group of randomly selected teachers from both rural and urban Morogoro who have misconceptions, and an inability to link various environmental concepts or to contextualize examples and questions they were asked. In addition, the student-teachers have minimal sense of duty and active participation in environmental activities like rallies, marches, or environmental petitions. This can be fuelled by the absence of opportunities and resources, for example, money and skilled personnel to initiate those activities/projects.

The findings from this study are significant as they explored levels and relationships between cognitive elements and environmental behaviours among prospective student-teachers. In comparison, it was unveiled that, on average, individual behavioural performance was more consistent than that cognitive performance. That is, the prospective student-teachers might have a positive attitude towards acting to solve environmental problems but did not necessarily have vast knowledge of environmental matters. These results are parallel with the results obtained by Akman, and Alagoz, (2017) that prospective teachers' environmental behavioural tendencies are higher than environmental perceptual tendencies.

Conclusion

The results showed that prospective student teachers arrive in college with a rich background of environmental concerns from family and educational experiences. They were knowledgeable of basic facts about the environment and possessed some responsible behaviours including discipline in protecting and serving the environment. However, they have limited information on burning environmental issues such as pollution, loss of biodiversity and climate change. To achieve greater relevance and meaning in their training, it is important for the college curriculum

to tap into their rich knowledge and understanding and provide environmental insights into the deprived areas.

Recommendations

Results from this study suggest the need to instil environmental literacy in students who choose to train as educators. Teacher training programmes should consider characteristics of the student population, which are outcomes from their individual knowledge, attitudes and behavioural elements and include all necessary components for adequately preparing educators who are effectively involved in building environmental competences for their future students. Future studies should examine how the level of environmental awareness among prospective teachers' is reflected and manifested in their course of learning and eventually, teachers become the suitable engine for transferring the environmental agenda to society.

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