Agrisost | Vol. 29, January-December 2023: 1-8

ISSN-e: 1025-0247

Toward an Environmental Education of Students at the Faculty of Natural Sciences, the University of Namibe

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Citation: Augusto de Filipe André, U. J., Sarmento do Santos, A. P., Portuondo Savón, O., Pérez Benitez, M., & Velázquez Labrada, Y. R. (2023). Toward an Environmental Education of Students at the Faculty of Natural Sciences, the University of Namibe. *Agrisost*, *29*, 1–8. https://doi.org/10.5281/zenodo.10778292

Received: November 8th, 2022 Accepted: January 15th, 2023 Published: July 17, 2023

Financiamiento: Not declared.

Conflictos de interés: Not declared.

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Abstract

Context: Today, quite a few environmental problems require swift responses toward adjustment, mitigation, and sustainability. Accordingly, how could university students acquire effective environmental education so they can play their social roles in balance with environmental protection?
Aim: To recommend methodological actions to contribute to student education at the Faculty of Natural Sciences, the University of Namibe, Angola.
Methods: Consequently, this study took from qualitative methods of social research. Methods and techniques, such as analysis-synthesis, inductive-deductive, and documentary review for processing information about environmental education and climate change in university education.
Results: Five methodological guidelines for environmental education were established. They were inserted in subject Physics II, in the first year of the Marine Biology Bachelor Degree, with six general actions that link theory and practice, through the teaching process in the degrees of Oceanography, Marine Biology, and Marine Resources. The study demonstrated the fulfillment of learning objectives related to Sustainable Development Goals No. 13 and 14, based on UNESCO (2017) guidelines.
Conclusions: There is a potential for students to acquire environmental information through methodological actions by the staff, in terms of subject preparation at the Faculty of Natural Sciences, the University of Namibe.

Keywords: *climate change, sustainable development, higher education, environment.*

Introduction

Climate change constitutes one of the most pressing environmental problems globally due to the high impact withstood by ecosystems (IPCC, 2014). In that sense, the Sustainable Development Goals (SDG) No. 13 and 14, approved by the United Nations in 2015, call for the need to ensure that every student acquires theoretical and practical knowledge to promote sustainable development and improve education, sensitization, and human and institutional capacity for mitigation, adjustment, early alert, and reduction of the effects of climate change (United Nations, 2018).

In Africa, some of the major threats are hurricanes, severe droughts, and increased temperatures, which have caused desertification and a rise in sea levels (Colom Jaén, A., 2022). The Republic of Angola, in particular, is vulnerable to the effects of climate change, thus posing new challenges to the professional education of young students to engage consciously in sustainable development processes (Ruiz Turcaz et al., 2022). Nzumba Sanuca (2018), in a study done by the Ministry of Environment and Fishing, and the United Nations Program for Development (UNDP), in 2005, through a biodiversity project, demonstrated an increased

number of climatic consequences and the incidence of man in the trends of environmental degradation.

The Angolan Constitution, article 21, item m, states that among the functions of the state are harmonious and sustainable development nationwide, for the protection of the environment and the national resources. Article 39 refers to environmental protection (Angola. Constituição da República de Angola, 2010, pp.10, 16). Moreover, the National Assembly endorses environmental education as a duty and right of the people to understand the phenomena of environmental balance (Basic Environmental Law 5/98, article No. 4, item a). National Assembly, 1998).

It strengthens the importance of environmental education to find solutions to the existing environmental issues in the local communities (González Ordóñez, 2016; Torres Rivera et al., 2018; Primelles et al., 2020). Environmental education, particularly should be holistic, integrating student cognition, attitudes, and behaviors (Velázquez, Romero et al., 2021). It is part of the aspects required for sustainable development education, which trains students to accomplish their goals and objectives for sustainable development, including the environmental dimension (UNESCO, 2012, 2017, 2020).

That way, educational institutions are engaged in the education of society in terms of climate (Díaz Fernández, 2018; Kranz et al., 2022) and sustainability (Filho, 2009; Sauvé, 1996; Yadav et al., 2022). The higher education institution must be in charge of student training to understand the dynamics of the behavior of coastal ecosystems, the socioeconomic context, and the ways to accomplish proactive behavior in favor of environmental sustainability in the area of climate change and post-COVID-19 (Bates et al., 2021; Soto et al., 2021). The above must be implemented through the teaching process and didactics in education (Torres et al., 2017; Ordóñez-Arcia, 2020; Abreu-Valdivia et al., 2021; Lopes & Abílio, 2022).

Recent studies recognize the main issues to be included in the Angolan educational system, such as the link between the objectives of the curricular project to environmental education (Ruiz Turcaz et al., 2022). Besides, it is important to have an environmental education strategy within the curriculum, which can be directed toward sustainability and development (Nzumba Sanuca, 2018). Besides, it requires the implementation of methods that favor more efficient and contextualized student education, in keeping with the demands and necessities (Simões Cacuassa, A. S., & Yanes López, G., 2019). Accordingly, the aim of this paper is to recommend methodological actions to contribute to environmental student education at the Faculty of Natural Sciences, the University of Namibe, Angola.

Materials and methods

Methods

This research study took place at the Faculty of Natural Sciences, the University of Namibe, Angola. Consequently, this study took from qualitative methods of social research. Methods and techniques, such as analysis-synthesis, inductive-deductive, and documentary review for processing information about environmental education and climate change in university education in the Angolan and international contexts. The curricula of Bachelor Degrees in Marine Biology, Oceanography, and Natural Resources were reviewed. The actions for environmental education on climate change were implemented in university student education, as described by Velázquez, Pérez et al. (2021), which were changed for implementation at the Faculty of Natural Sciences, the University of Namibe, Angola.

Results and discussion

Environmental education in university students is assumed as a comprehensive process of knowledge, habits, skills, capacities, values, and assessments that favor reflexive thinking, depending on the characteristics of human nature, which are conditioned by the historical epochs through the socialization of experiences that vary throughout time. They are developed, transformed, and contextualized through the educational process in favor of responsible environmental performance looking for sustainable development (Velázquez, Romero, et al., 2021).

Accordingly, this study recommends methodological actions to contribute to environmental student education at the Faculty of Natural Sciences, the University of Namibe, Angola.

1. To conduct office work to determine the demands associated with environmental education found in the governing documents, professional profiles, and methodological instruments of each degree.

In this case, it is important to determine the gradual derivation of objectives, content, and skills by academic year, and their relationship to the SDGs that deal with better understanding of environmental sustainability, the conservation of coastal-marine biodiversity, and food production. Based on this perspective, it is important to determine each of the components mentioned and their contribution to understanding the different Sustainable Development Goals (UN, 2018) with emphasis on SDG No. 4 Education and Quality; No.12 Responsible Production and Consumption; No.13 Action toward

Climate; No.14 Underwater Life; No.15 Life of Ground Ecosystems.

2. To develop several ways of scientific and methodological work among the members of each discipline and degree staff, where the most relevant content in the syllabus can be reviewed, so that students have the basis of cognitive relationships that allow them to find explanations to the surrounding environmental issues, the main threats associated with climate change.

To determine the primary and secondary content in each period in every subject, so that teachers are capable of mastering the elements of knowledge delivered in the class that favor the study of these topics. Moreover, it will deal with the interconnected interdisciplinary ways in which cognitive nodes work so that students are capable of explaining environmental problems, their causes, consequences, adjustment and mitigation measures, as well as the concepts that ensure the implementation of Sustainable Development Goals and their targets.

3. To determine the contribution of each subject to the development of professional competencies and skills for the completion of innovative proposals that tackle local environmental issues, both for adjusting and mitigating climate change impacts.

4. To introduce assessment ways not only based on self-assessment and hetero-assessment but also co-assessment to address current issues, the implementation of case studies, or the analysis of some already published in the literature. (Table 1).

Table 1. Example of environmental education through a subject, at the Faculty of Natural Sciences, the University of Namibe, Angola

DEGREE Marine Biology					
ACADEMIC YEAR: First					
SUBJECT: Physics II					
Demands related to environmental education in the governing documents of the degree.	To develop a scientific spirit in the students, in accordance with their knowledge of Physics, so that they are able to address issues detected in different contexts, and protect and maintain the marine and coastal environment.				
Demands related to environmental education in the subject's programs	Understanding of knowledge and its association with other sciences, new technologies, and social problems in the professional context.				
Objectives related to environmental education.	To explain the laws and principles linked to knowledge about the atmosphere	To explain the movement of fluids. Laminar flow according to the characteristics of the different biological species and their relationships to the marine and coastal environment.	To explain fluid viscosity by observing laboratory samples, and to recommend measures to mitigate the effects of environmental climate changes.	To explain the properties of gases, their ideal state, and the importance of maintaining proper relationships in the marine and coastal ecosystems.	To assess the significance of the study of gases to maintain the marine and coastal ecosystems in balance.
Content linked to environmental education and the objectives they contribute to	Atmospheric pressure	Fluid movement	Viscosity coefficient measurements	Properties of gases	Kinetic theory of gases
Local environmental problems to be dealt with	Deposit of residues in different contexts	Deposit of polluted river and ocean waters, and effects on organisms.	Effect of polluted water in organisms.	High concentrations of gases are caused by malpractice, such as the burning of solid residues.	Problems with decision-making.
Professional and/or environmental competencies developed.	To be able to explain physical phenomena associated with atmospheric pressure.	To be able to explain physical phenomena associated with fluid movements.	To be able to explain physical phenomena associated with fluid viscosity.	To be able to assess physical phenomena associated with gases.	To be able to explain physical phenomena associated with gases.
Methods developed	Observation	Explication-illustrative	Joint design.	Experimentation.	Modeling.
Assessment forms	Seminars,	First group: To	Second group:	Third group: To	Final exam: To

	workshops, oral and written questions.	explain the movement of fluids. Laminar flow according to the characteristics of the different biological species.	To explain fluid viscosity by observing laboratory samples.	explain the properties of gases	assess the significance of the study of gases.

5. To harmonize the academic aspects with other university processes to enhance theory-practice and space-time management. From this perspective, this study recommends a comparison between the lifespan of natural species, the formation and occurrence of abiotic and socioeconomic processes, and the average time in which human activity affects them, thus contributing to proactive environmental student education to a culture of safety and climate protection.

In that sense, several university degrees have taken the following actions:

- Consolidation of environmental education in Oceanography, Marine Biology, and Marine Resources at the Faculty of Natural Sciences, the University of Namibe, Angola, through the curriculum, expressed in the final course papers and the skills developed by the students to address environmental issues locally.
- To perform activities on different beaches and coastal areas in Moçamedes, by the awareness created toward aspects that damage the coastal environment and the different species in danger of extinction.
- To create scenarios to spread scientific results that help protect the local endemic species.
- To design three research projects, plus one community project comprising actions to protect the environment.
- To project fish feed production to mitigate the effects of environmental changes and uncontrolled fishing on the coasts. Likewise, students acquire skills and knowledge from every subject, such as Ictiology, Anatomy, Physiology, Ecology, Zoology, and Marine Botany.
- To take action through the teaching, research, innovation, and off-campus processes to implement the learning objectives stated by UNESCO (2017), particularly those related to SDGs No.13 and 14.

Table 2. Actions taken to meet the learning objectives related to the Sustainable Development Goal No. 13 Climate Action, based on UNESCO (2017) guidelines

Cognitive learning objectives of SDG No.13 (UNESCO, 2017)	Main actions taken through university processes at the Faculty of Natural Sciences, the University of Namibe, Angola.		
	TEACHING	RESEARCH AND INNOVATION	OFF-CAMPUS ACTIVITIES
1. Students conceive the greenhouse effect as a natural phenomenon caused by an isolating layer of greenhouse gases.	Content from subjects Chemistry, Physiology of Marine Organisms, Ecology, Physical Qualities of the Water, Physics, and General Biology.	Monitoring of some threatened species and recommended action plans for conservation depending on the environment they inhabit.	Presentation of the results in the communities, theses, and off-campus projects.
2. Students conceive the current climate change as an anthropogenic phenomenon caused by an increase in the emissions of greenhouse gases.			
3. Students know the type of human actions globally, nationally, locally, and individually that contribute most to climate change.			
4. Students know about the major ecologic, social, cultural, and economic consequences of climate change locally, nationally, and globally, and they can understand how these may become catalyzers and enforcers of climate change.			
5. Students know about the strategies for prevention, mitigation, and adjustment at different levels (worldwide through			

personal), and contexts, as well as their links to responses to disasters, and disaster risk reduction.			
Social-emotional learning objectives			
1. Students are able to explain the dynamics of the ecosystem and the environmental, social, economic, and ethical impacts of climate change.	Ecology, Biology, Oceanography, Genetics, Physiology, and Accounting.	To recommend measures for the conservation of species depending on the climate characteristics where they live.	Presentation of the results in the communities, theses, and off-campus projects.
2. Students are able to encourage others to protect the climate.	Content from subjects Chemistry, Physiology of Marine Organisms, Ecology, Physical Qualities of the Water, Physics, and General Biology.	To recommend measures for the conservation of species depending on the climate characteristics where they live.	
3. Students are able to collaborate with others to design common strategies to deal with climate change.	Content from subjects Chemistry, Physiology of Marine Organisms, Ecology, Physical Qualities of the Water, Physics, General Biology, Research Methodology, and Thesis dissertation workshops.		Lessons and final classwork
4. Students are able to understand their impact on world climate with a local perspective.	Content from subjects Chemistry, Physiology of Marine Organisms, Ecology, Physical Qualities of the Water, Physics, General Biology, discussion sessions, meetings, and conferences.		To attend various meetings.
5. Students are able to recognize that world climate protection is a collective endeavor and that the vision of the world should be reassessed along with the people's daily conduct.	Content from subjects Chemistry, Physiology of Marine Organisms, Ecology, Physical Qualities of the Water, Physics, General Biology, and systematic preparations for term papers.		To attend various meetings.
Behavioral learning objectives			
1. Students are able to evaluate if their private and professional activities respect the climate, and in case they do not, examine them.	Lessons and term papers	Exchanges with people from different areas, companies, and research facilities.	To develop a culture for the protection of the environment, and influence other contexts.
2. Students are able to act in favor of people threatened by climate change.			
3. Students are able to anticipate, estimate, and evaluate the impact of decisions or personal, local, and national activities on other people and parts of the world.			
4. Students are able to encourage public policies for the protection of climate.			
5. Students are able to support climate-friendly economic activities.			

Table 3 Actions taken to meet the learning objectives related to the Sustainable Development Goal No. 14 Life below Water, based on UNESCO (2017) guidelines

Cognitive learning objectives of SDG No.14 (UNESCO, 2017)	Main actions taken through university processes at the Faculty of Natural Sciences, the University of Namibe, Angola.

	TEACHING	RESEARCH AND INNOVATION	OFF-CAMPUS ACTIVITIES
1. Students understand basic marine ecology, ecosystems, predator-prey relationships, etc.	Content from subjects Marine Biology, Global Aquatic Resources, Oceanography, Marine Ecology, and Physiology of Marine Organisms.	Exchanges with people from different areas, companies, and research facilities.	Presentation of the results in the communities, theses, and off-campus projects.
2. Students understand the link many people have to the ocean and marine life, including the role of the ocean as a source of food, labor, and opportunities.			
3. Students know the basic premises of climate change and the role of oceans in modeling climate.			
4. Students understand the threats to oceanic systems, such as pollution and uncontrolled fishing, and recognize and may explain the relative fragility of many oceanic ecosystems, including coral reefs and dead hypoxic zones.			
5. Students know about opportunities for sustainable use of living marine resources.			
Social-emotional learning objectives			
1. Students are able to defend sustainable fishing practices.	Content from subjects Marine Biology, Global Aquatic Resources, Marine Ecology, and Physiology of Marine Organisms.	Exchanges with people from different areas, companies, and research facilities.	Presentation of the results in the communities, theses, and off-campus projects.
2. Students are able to demonstrate to people the impact of man on the oceans (loss of biomass, acidification, pollution, etc.), and the importance of healthy, clean oceans.			
3. Students are able to influence groups engaged in the production and consumption of products from the ocean.			
4. Students are able to reflect on their own nutritional needs, and if their feeding habits are sustainable, considering the limited marine resources.			
5. Students are able to empathize with people whose sustenance is affected by changes in fishing practices.			
Behavioral learning objectives			
1. Students are able to research how their country depends on the oceans.	Content from subjects Oceanography, Marine Ecology, and Physiology of Marine Organisms.	Exchanges with people from different areas, companies, and research facilities.	Presentation of the results in the communities, theses, and off-campus projects.
2. Students are able to discuss sustainable methods, such as strict fishing quotas and moratoriums for threatened species.	Ecology, Biology, Oceanography, Genetics, Physiology, and Accounting.		
3. Students are able to detect, access, and purchase marine resources exploited sustainably, for instance, certified products with ecological labels.	Ecology, Biology, Oceanography, Genetics, Physiology, and Accounting.		
4. Students are able to contact their representatives to talk about uncontrolled fishing as a threat to local sustenance.			
5. Students are able to defend the expansion of non-fishing areas and marine reserves and advocate for their protection with a scientific perspective.			

Conclusions

The analysis of the theoretical referents about environmental education in university students revealed the importance of their treatment for adjustment or mitigation of impacts in light of the danger associated with climate change in every region. This requires inter and multi-disciplinary

integration among objectives, content, methods, skills, means, and evaluations so they can be associated with specific sciences related to environmental issues, especially those influencing the protection of marine biodiversity directly.

This study recommends five methodological guidelines that contribute to environmental education in students, considering the requirements of this type of governing documents in university degrees, the analysis of the knowledge systems that permit further actions for adjustment and mitigation of the impacts of climate change in the province studied, and therefore implement education strategies for sustainable development using the different scientific and methodological spaces. It can be evidenced in the subject Physics II, the first year of the Bachelor's Degree in Marine Biology, at the Faculty of Natural Sciences, the University of Namibe.

Six general actions that permit an association between theory and practice through the teaching process in the degrees of Oceanography, Marine Biology, and Marine Resources. The study demonstrated the fulfillment of learning objectives related to the Goals of Sustainable Development No. 13 and 14, based on UNESCO (2017) guidelines.

Author contribution statement

Ubaldo Jorge Augusto de Filipe André: conception, redaction of the manuscript, results, conclusions, and final review.

Ana Paula Sarmento do Santos: conception, redaction of the manuscript, results, conclusions, and final review.

Onelis Portuondo Savón: conception, redaction of the manuscript, results, conclusions, and final review.

Mayelin Pérez Benitez: conception, redaction of the manuscript, introduction, methodology, bibliography, and final review.

Yunior Ramón Velázquez Labrada: conception, redaction of the manuscript, introduction, methodology, bibliography, and final review.

Conflict of interest statement

Not declared.

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