مدى تحقيق برنامج GLOBE لأهداف التنمية المستدامة وتعزيز المواطنة البيئية بين الطلبة العُمانيين

The Extent to Which the GLOBE Program Achieves Sustainable Development Goals and Promotes Environmental Citizenship Among Omani Students

د. أحمد بن موسى بن محمد البلوشي: مدير دائرة قطاع العلوم، وزارة التربية والتعليم، سلطنة عمان
مريم بنت سعيد بن علي باعوين: رئيسة قسم الابتكار والأولمبياد العلمي، وزارة التربية والتعليم، سلطنة عمان

Dr. Ahmed Moosa Mohammed Al Balushi: Director of the Science Sector Department, Ministry of Education, Sultanate of Oman
Email: falaj99@hotmail.com

Maryam Said Ali Bauwain: Head of the Innovation and Science Olympiad Department, Ministry of Education, Sultanate of Oman
Email: mariam52010@moe.om

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الملخص:

هدفت الدراسة إلى معرفة مدى مساهمة برنامج GLOBE في تحقيق أهداف التنمية المستدامة، وتعزيز المواطنة البيئية لدى الطلبة العُمانيين، حيث يُعدّ التعليم البيئي أداةً أساسيةً لمواجهة التحديات العالمية، مثل تغير المناخ والاستدامة. وتكمن مشكلة الدراسة في تقييم أثر البرنامج على سلوكيات الطلبة ومعتقداتهم البيئية، بالإضافة إلى وجهات نظر المعلمين والمعلمات حول فعاليته في تحقيق أهداف التنمية المستدامة المتعلقة بالتعليم والوعي البيئي. اعتمدت الدراسة على منهجية وصفية، شملت عينةً من 400 طالب، و200 مشارك في برنامجGLOBE ، و200 غير مشارك في البرنامج، من 44 مدرسة عُمانية خلال العام الدراسي 2025/2024. واستُخدمت أداتان رئيسيتان: استبانة لقياس المواطنة البيئية لدى الطلبة، واستبانة لقياس تقييمات المعلمين لدور البرنامج في تحقيق أهداف التنمية المستدامة. وأشارت نتائج الدراسة إلى أن برنامج GLOBE يعزز المواطنة البيئية بشكل كبير بين الطلبة المشاركين، مع تحقيق جميع المجالات المقاسة –المعرفة والسلوك والمشاعر والمعتقدات– بمستويات عالية أو عالية جدًا. وُجدت فروق ذات دلالة إحصائية بين المشاركين وغير المشاركين، لصالح الفئة الأولى. وكشفت الاختلافات القائمة على النوع الاجتماعي أن الطالبات أظهرن معتقدات بيئية أقوى وانخراطًا عاطفيًا من نظرائهن الذكور. وصنف المعلمون البرنامج على أنه فعال للغاية في تحقيق الأهداف المتعلقة بأهداف التنمية المستدامة، وخاصة في التعليم والعمل المناخي. وتوصي الدراسة بتعزيز البرنامج من خلال دمج المزيد من الأنشطة العملية لتعزيز المعرفة والسلوك البيئي للطلبة. كما تقترح الاستفادة من المعتقدات البيئية القوية للطلبة لتعزيز القيادة في مبادرات الاستدامة. ويُقترح توسيع نطاق البرنامج ليشمل المزيد من المدارس والفئات العمرية لتعظيم تأثيره على المواطنة البيئية وإنشاء نظام تعليمي وأدوات تهدف إلى تحقيق أهداف التنمية المستدامة.

الكلمات المفتاحية: المواطنة البيئية، أهداف التنمية المستدامة (SDGs)، برنامج GLOBE، التعليم البيئي، التعليم المستدام.

Abstract:

This study aimed to identify the extent to which the GLOBE Program contributes to achieving the Sustainable Development Goals (SDGs) and promoting environmental citizenship among Omani students. Thus, Environmental education is a crucial tool for addressing global challenges such as climate change and sustainability. The research problem lies in assessing the program's impact on students' environmental behaviours and beliefs, as well as teachers' perspectives on its effectiveness in achieving SDGs related to education and environmental awareness. The study employs a descriptive methodology, utilizing a sample of 400 students, 200 participants in the GLOBE Program, and 200 non-participants, from 44 Omani schools during the 2024/2025 academic year. Two primary tools were used: a questionnaire measuring students' environmental citizenship and a survey evaluating teachers' assessments of the program's role in achieving SDGs. The results indicate that the GLOBE Program significantly enhances environmental citizenship among participating students, with all measured domains—knowledge, behaviour, feelings, and beliefs—achieved at high or very high levels. Statistically significant differences were found between participants and non-participants, favouring the former. Gender-based differences revealed that female students demonstrated stronger environmental beliefs and emotional engagement than their male counterparts. Teachers rated the program as highly effective in achieving SDG-related objectives, particularly in education and climate action. The study recommended enhancing the program by integrating more hands-on activities to strengthen students' environmental knowledge and behaviour. It also suggested leveraging students' strong environmental beliefs to promote leadership in sustainability initiatives. Expanding the program to more schools and age groups is proposed to maximize its impact on ecological citizenship and to create an education system and tools aimed at achieving the SDGs.

Keywords: Environmental Citizenship, Sustainable Development Goals (SDGs), GLOBE Program, Environmental Education, Sustainable Education.

Introduction:

Environmental challenges such as climate change, biodiversity loss, and resource depletion have become pressing global concerns, necessitating innovative educational strategies to promote sustainability. Environmental education, which emphasizes the integration of environmental principles into teaching and learning processes, is a transformative approach aimed at fostering environmental awareness, critical thinking, and responsible citizenship among students (Hadjichambis & Reis, 2020). This approach aligns with the United Nations Sustainable Development Goals (SDGs), particularly SDG 4 (Quality Education) and SDG 13 (Climate Action) (UNESCO, 2017). The GLOBE Program (Global Learning and Observations to Benefit the Environment) supports these goals by integrating STEM learning with real-world environmental issues, enabling students to apply scientific inquiry and technological tools to address sustainability challenges.

The GLOBE Program offers a practical framework for implementing environmental education by connecting students, teachers, and scientists through hands-on environmental science activities. This collaboration fosters a deeper understanding of global environmental systems while promoting data collection and citizen science (GLOBE Program, n.d.). Studies have demonstrated the program's effectiveness in enhancing students' environmental awareness and scientific literacy, with measurable improvements in their attitudes and behaviors toward the environment (Hungerford & Volk, 1990).

In Oman, the implementation of the GLOBE Program has been pivotal in advancing environmental education. Al-Hadeede and Ambusaidi (2020) found that the program successfully engages students and teachers in environmental research, despite challenges such as technological limitations and the need for ongoing training. Furthermore, research by

(Qalhati, et al., 2023) revealed that GLOBE projects in Oman effectively incorporate key dimensions of scientific literacy, including problem-solving and the interplay between science, technology, and society. These studies highlight the potential of the GLOBE Program as an innovative model for achieving the Sustainable Development Goals (SDGs) in the Sultanate of Oman.

In recent years, Omani students have excelled in global scientific exhibitions, and national initiatives like the GLOBE National Forum for Education which have provided opportunities to showcase environmental research and data collection efforts (Oman Observer, 2021). Despite these successes, questions remain regarding the extent to which the GLOBE Program promotes environmental citizenship among students and contributes to the Sustainable Development Goals (SDGs) in Oman. Environmental citizenship involves responsible environmental behaviour, scientific literacy, and active participation in sustainability initiatives (Hadjichambis & Paraskeva-Hadjichambi, 2022). While research has demonstrated that the GLOBE Program enhances student engagement and scientific inquiry, its long-term impact on students' environmental behaviors and sustainability practices remains underexplored (Ardoin, et al., 2018). Additionally, evaluating teachers' perspectives on the program's effectiveness in achieving SDG-related educational outcomes is crucial for understanding its practical implementation challenges.

This prompted the GLOBE Program team in Oman to investigate the role of the GLOBE Program in promoting environmental citizenship among participating students. Environmental citizenship is defined as the ability to engage in civic actions that promote environmental sustainability, which is essential for addressing global environmental challenges (Dobson, 2007). The research also aimed to assess the extent to which the program, within the Omani context, has contributed to achieving the Sustainable Development Goals (SDGs). Additionally, it sought to develop a clear

understanding of how GLOBE schools in the Sultanate of Oman have implemented the program as an effective tool for advancing the SDGs.

Research Problem:

Based on the above, the research problem focuses on measuring the impact of the GLOBE Program, one of the global educational initiatives in which Oman participates. The study aimed to explore the program's effects from two main dimensions:

1. **The first dimension** investigates the extent to which the program contributes to promoting environmental citizenship among students. The research is grounded in the idea that environmental citizenship directly influences the achievement of Sustainable Development Goals (SDGs) through individuals' environmental behaviours and beliefs.
2. **The second dimension** evaluates teachers' assessments of the GLOBE Program regarding its effectiveness in achieving SDGs related to the environment and quality education.

Research Objectives:

Based on the research problem, the study aimed to achieve two main objectives:

1. To examine the impact of the GLOBE Program on promoting environmental citizenship among Omani students.
2. To assess the program's contribution to achieving the Sustainable Development Goals (SDGs) related to the environment and education, from the perspective of Omani teachers implementing the program.

Research Questions:

To achieve the research objectives and derive meaningful insights, the study addresses the following four questions:

1. To what extent does the GLOBE Program contribute to enhancing environmental citizenship among participating students?
2. Are there statistically significant differences in the dimensions of environmental citizenship between students participating in the program and those who are not?
3. Are there statistically significant differences in the dimensions of environmental citizenship among participating students based on gender?
4. To what extent does the GLOBE Program contribute to achieving Sustainable Development Goals (SDGs) from the perspective of teachers?

Research Importance:

The GLOBE Program primarily aimed to foster environmental awareness by engaging students in hands-on scientific investigations. Through data collection and analysis, students develop a deeper understanding of ecological systems and sustainable practices, thereby promoting environmental citizenship (Office of Science and Technology Policy, 2010). Research has shown that experiential learning approaches empower students to make informed decisions and take responsible actions toward environmental sustainability (Office of Science and Technology Policy, 2010).

The United Nations Sustainable Development Goal (SDG) 4 emphasizes inclusive, equitable, and quality education that promotes lifelong learning. The GLOBE Program's inquiry-based learning model aligns with this goal by enhancing students' scientific competencies and encouraging critical thinking. By integrating sustainability concepts into education, the program plays a vital role in fostering environmental responsibility and supporting broader SDG objectives.

Educators play a pivotal role in integrating sustainability concepts into classrooms. Else, the GLOBE Program provides teachers with a structured framework, protocols, and learning resources that enhance environmental science education (Harvard University, 2025). These tools enable teachers to facilitate experiential learning, thereby enhancing the effectiveness of education in achieving both environmental and quality education goals (Harvard University, 2025).

Inspired by the above, researchers have identified three key reasons why this is important, as summarized in Figure 3 below.

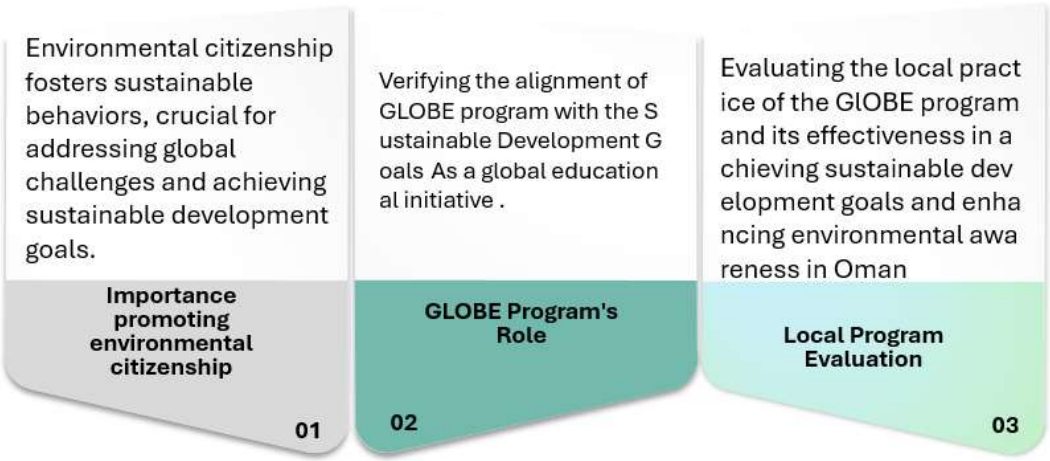

Figure1: Research Justifications

Delimitations of Research:

This research examines the impact of the GLOBE Program through the implementation methods followed by participating teams, which include students from grades five to ten in schools across the Sultanate of Oman during the academic year 2024/2025. The study focuses on evaluating the program's effectiveness in promoting environmental citizenship among participating students, comparing them to their non-participating peers. Additionally, it assesses the program based on teachers' perspectives regarding its contribution to achieving Sustainable Development Goals (SDGs) related to the environment and quality education, using descriptive questionnaires for data collection.

Literature Review:

Environmental Citizenship:

Environmental citizenship is defined as "the responsible pro-environmental behavior of citizens who act and participate in society as agents of change in both private and public spheres, on local, national, and global scales, through individual and collective actions, aiming to solve contemporary environmental problems, prevent the creation of new environmental issues, achieve sustainability, and develop a healthy relationship with nature" (Cao, 2018). It encompasses actions such as recycling, conservation, and political activism to support environmental policies (Dobson, 2007). According to Dobson and Bell (2006), and Hadjichambis and Reis (2020), environmental citizenship consists of several key components: knowledge, beliefs, behaviors, emotions, and participation.

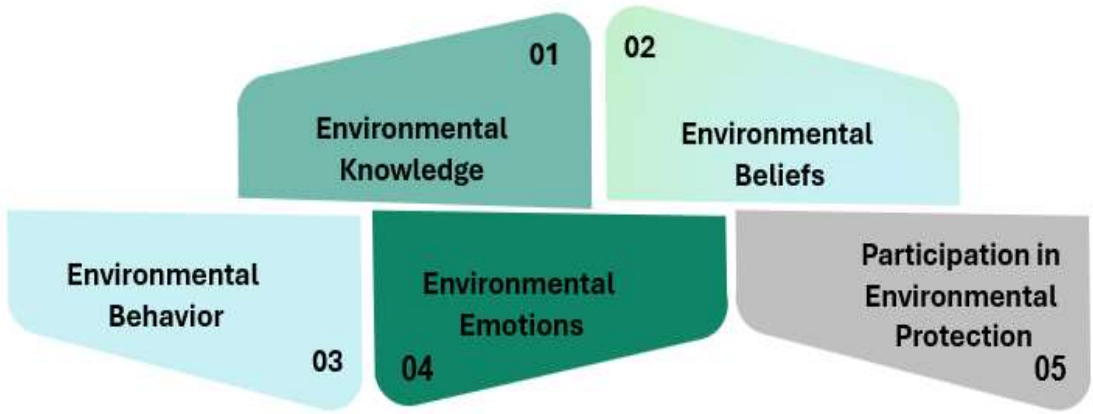

Figure 2: Environmental Citizenship Pillars

- **Environmental Knowledge** is a fundamental component that ensures individuals understand ecological issues, sustainability principles, and the impact of human activities on the environment (Hadjichambis & Reis, 2020). Education plays a crucial role in fostering environmental awareness by integrating ecological principles into curricula and public discourse.

- **Environmental Beliefs** shape individuals' attitudes toward environmental responsibility. A strong belief in sustainability and ecological preservation influences people's commitment to making environmentally friendly choices (Dobson & Bell, 2006). Environmental behaviors reflect the actions taken by individuals to reduce their environmental footprint. This includes reducing waste, conserving energy, and supporting sustainable policies (Hadjichambis & Reis, 2020). Environmental citizenship encourages responsible behaviors that benefit both local and global ecosystems.
- **Environmental Emotions** play a significant role in environmental citizenship by fostering a sense of connection with nature. A strong emotional attachment to the environment can drive individuals to act against environmental degradation (Dobson & Bell, 2006).
- **Environmental Participation** involves active engagement in environmental initiatives, including advocacy, conservation projects, and policymaking. By participating in these activities, individuals contribute to sustainable development and promote collective environmental responsibility (Hadjichambis & Reis, 2020).

By integrating these components, environmental citizenship fosters a culture of sustainability and collective responsibility.

Sustainable Development Goals (SDGs):

The Sustainable Development Goals (SDGs) are a set of 17 interconnected objectives established by the United Nations in 2015. They aim to tackle global challenges—including poverty, inequality, climate change, environmental degradation, peace, and justice—with the overarching goal of creating a more sustainable and equitable future for all by 2030 (United Nations, 2015).

The sustainable development goals associated with the GLOBE program:

The GLOBE program provides a set of standardized measurement protocols across various environmental domains, including the atmosphere, biosphere, hydrosphere, and pedosphere. These protocols enable participants to collect accurate and consistent data, contributing to a global database used by scientists and educators. For example, the GLOBE Teacher's Guide offers detailed instructions on data collection methods, ensuring uniformity and reliability in the gathered data (GLOBE Program, n.d.).

Based on these protocols, the Sustainable Development Goals (SDGs) associated with the GLOBE Program include:

- **Goal 4: Quality Education** – Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all (United Nations, 2015).
- **Goal 6: Clean Water and Sanitation** – Ensure the availability and sustainable management of water and sanitation for all (United Nations, 2015).
- **Goal 7: Affordable and Clean Energy** – Ensure access to affordable, reliable, sustainable, and modern energy for all (United Nations, 2015).
- **Goal 13: Climate Action** – Take urgent action to combat climate change and its impacts (United Nations, 2015).
- **Goal 15: Life on Land** – Protect, restore, and promote the sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt biodiversity loss (United Nations, 2015).

Figure 3: SDGS Associated with The GLOBE Program

A notable discussion on the GLOBE Program's impact on the Sustainable Development Goals (SDGs) took place during the Science Summit at the United Nations General Assembly (UNGA77) in September 2022. During this event, representatives from various countries shared case studies demonstrating how GLOBE's implementation contributes to national and global sustainability goals, particularly in climate action, environmental education, and responsible resource management (GLOBE Program, 2022).

Moreover, in 2019, NASA and the United Nations Environment Programme (UNEP) formalized a collaboration to integrate the GLOBE Program with UNEP's environmental initiatives (GLOBE Program, 2019). This agreement aimed to enhance environmental education and citizen science, leveraging NASA's technological and scientific expertise to expand global access to environmental data (GLOBE Program, 2019).

Despite these institutional efforts, peer-reviewed research directly analyzing the GLOBE Program's impact on achieving the Sustainable Development Goals (SDGs) remains limited. However, the program's emphasis on data-driven environmental education and international cooperation aligns with key SDGs, particularly Climate Action (SDG 13) and Quality Education (SDG 4), reinforcing its value in the broader sustainability landscape.

Previous Studies:

Science-based educational interventions have been widely studied as a means to enhance students' environmental awareness and citizenship. Research suggests that hands-on, interactive learning experiences significantly improve students' knowledge, attitudes, and behaviors regarding environmental issues.

Wyles et al. (2017) investigated whether participation in beach clean-up activities could enhance environmental awareness more effectively than other coastal activities. The study recruited participants and divided them into three groups: those engaging in beach clean-ups, rock pooling, and coastal walking. Researchers conducted surveys before and after the activities to assess changes in environmental awareness, mood, and behavioral intentions. Findings revealed that individuals who participated in beach clean-ups showed a more substantial increase in environmental awareness and pro-environmental intentions compared to the other groups. The study concluded that hands-on conservation activities, such as organized clean-ups, should be encouraged to foster environmental engagement.

Baek et al. (2023) introduced a novel approach by integrating computer science with environmental and data literacy within a community-based learning framework. Their study focused on a fifth-grade special education classroom consisting of multilingual Latinx students. The intervention utilized Scratch programming, allowing students to create interactive projects based on locally collected environmental data. By linking environmental education with computational thinking, the researchers found that students not only deepened their understanding of environmental issues but also developed valuable technical skills. The study recommended expanding interdisciplinary curricula that merge technology and environmental education to better serve diverse student populations.

Skinner and Chi (2012) explored the role of garden-based learning in fostering environmental engagement among students. Using self-determination theory as a framework, they examined how hands-on gardening activities influenced intrinsic motivation and engagement in environmental education. Their research, conducted with elementary school students, found that active participation in gardening significantly increased students' environmental awareness and pro-environmental behaviors. The study emphasized the importance of interactive, nature-based learning experiences and recommended that schools incorporate outdoor educational programs to cultivate environmental responsibility among young learners.

The Reality of Implementing the GLOBE Environmental Program in the Sultanate of Oman: Perspectives of Students and Teachers. This study examined the implementation of the GLOBE Program in Oman from the perspectives of 155 students and 35 teachers across five governorates. Using questionnaires and interviews, the study found that most program objectives were achieved, implementation procedures were appropriate, and participants developed positive environmental behaviors. No significant gender-based differences were observed. However, some participants faced challenges. The study recommended ongoing training for students and teachers, integrating the GLOBE Program into science curricula, and conducting a comparative study on scientific inquiry skills between participating and non-participating students (Al-Hadeede & Ambusaidi, 2020).

The Inclusion of Scientific Literacy Dimensions in GLOBE Environmental Program Projects in Oman. This study by Al-Qalhati, et al. (2023), examined the integration of scientific literacy dimensions in projects within the GLOBE Environmental Program in Oman, aligning with SDG 4 (Quality Education). Using a content analysis tool with 29 indicators. Also, Assessing four key dimensions: Thinking and problem-solving (36.9%),

Scientific investigation (23.4%), Scientific knowledge (20.3%). The relationship between science, technology, society, and the environment (STSE) (19.3%). While all dimensions were present, the STSE dimension was the least addressed. The study recommended increasing its inclusion and integrating GLOBE projects into curricula to enhance students' scientific literacy and critical thinking skills.

Additionally, Salame et al. (2020) conducted a study on the implementation of the GLOBE Program in nine New York City public schools. The findings indicated that the program had a positive impact on both teachers and students, introducing a new approach to learning for grades 6–12 science education. Teachers reported increased student interest in science and noted that the program enhanced inquiry-based learning within their curricula.

Collectively, these studies suggest that engaging students in science-based environmental activities, including the GLOBE Program, through direct conservation actions, interdisciplinary approaches, or experiential learning, enhances their environmental awareness and fosters responsible citizenship. The findings emphasize the importance of integrating hands-on, community-based, and technology-enhanced learning strategies to effectively cultivate environmental responsibility among students.

Research Methodology:

This study employed a descriptive research methodology to analyze the implementation and impact of the GLOBE Program.

Research Population and Sample:

During the 2024/2025 academic year, the GLOBE Program is being implemented in 44 schools, supervised by 44 teachers, with 200 students enrolled in the program, according to the survey conducted for this study.

Additionally, the research included a comparison group of 200 students who are not participating in the program to facilitate necessary comparisons.

Research Tools:

1. A questionnaire is used to measure environmental citizenship among Omani students.

Based on the literature review, this research examined environmental citizenship through five key sections. The questionnaire employs a five-point Likert scale, where respondents indicate the extent to which they agree with each statement, using the following scale:

First. Environmental Knowledge:

1. I understand how daily human activities impact the environment.
2. I know the meaning and significance of recycling.
3. I learn about environmental issues through school, the internet, or other sources.
4. I can explain the importance of conserving water and energy.
5. I am aware of climate change and its effects on our lives.
6. I understand key environmental concepts and characteristics (e.g., acidity, conductivity, oxygen levels).

Second. Environmental Beliefs:

1. I believe that protecting the environment is everyone's responsibility.
2. I think littering in public places harms the environment.
3. I believe that preserving nature improves our quality of life.
4. I think school education helps us understand the importance of the environment.
5. I believe that everyone plays a role in reducing pollution.
6. I believe that using renewable energy is beneficial.

Third. Environmental Behaviours:

1. I ensure that waste is disposed of properly.
2. I help clean the environment at school or in my community.
3. I turn off lights when leaving a room to save energy.
4. I try to reuse items instead of discarding them.
5. I discuss the importance of environmental protection with my friends.
6. I participate in environmental activities, such as tree planting.

Fourth. Environmental Emotion:

1. I feel saddened when I see nature being destroyed.
2. I think preserving nature enhances our lives.
3. I feel happy when I see people caring for plants and animals.
4. I feel concerned about the amount of trash in my area.
5. I enjoy learning about the environment and nature.
6. I feel proud when I help protect the environment.

Fifth. Participation in Environmental Protection:

1. I participate in environmental cleanup campaigns with my school.
2. I help my friends and family understand the importance of recycling.
3. I take part in school discussions about environmental issues.
4. I contribute to planning environmental protection activities at school.
5. I encourage others to plant trees and greenery at home.
6. I participate in environmental competitions or events.

A survey sample of 40 students was used to measure the validity and reliability of the questionnaire. The internal consistency validity for each section of the questionnaire was calculated as follows:

Table 1: Description of the First Questionnaire

Sections	Number of Items	Internal Consistency Coefficient
Environmental Knowledge	6	0.807
Environmental Beliefs	6	0.836
Environmental Behaviour	6	0.825
Environmental Feelings	6	0.878
Environmental Participation	6	0.901

Based on the table, all sections demonstrate a high level of validity, indicating strong internal consistency within each section. Additionally, the reliability coefficient (Cronbach's Alpha) for all items combined was 0.949, reflecting an exceptionally high level of reliability in the questionnaire. This suggests that the items are strongly correlated and cohesive, reinforcing the questionnaire's robustness as a single measurement tool.

2. A form designed to assess teachers' evaluation of the extent to which the GLOBE Program contributes to achieving Sustainable Development Goals (SDGs) within the Omani context. The responding teacher selects the degree of achievement for each item using a five-point Likert scale.

The form is structured into the following sections and corresponding items:

Section 1: Students' Awareness of Sustainable Development Goals (SDGs)

1. The program introduces students to the Sustainable Development Goals (SDGs) related to the environment.
2. GLOBE Program participants recognize the importance of the environment and its role in sustainable development.
3. The program enhances students' understanding of both local and global environmental issues.

4. Students connect their program activities to SDGs such as **Climate Action (Goal 13)** and **Life on Land (Goal 15)**.

Section 2. The Program's Impact on Sustainable Behaviours:

1. Students demonstrate environmentally responsible behaviours, such as waste reduction and recycling.
2. The program encourages active students' participation in sustainable environmental initiatives.
3. Students propose innovative solutions to environmental challenges.
4. Students contribute to raising environmental awareness within their schools and local communities.

Section 3. Contribution to Specific Sustainable Development Goals (SDGs):

1. Goal 6: Clean Water and Sanitation – Enhancing students' understanding of water conservation and management.
2. Goal 7: Affordable and Clean Energy – Raising awareness of sustainable energy sources.
3. Goal 13: Climate Action – Increasing understanding of climate change impacts and encouraging proactive measures.
4. Goal 15: Life on Land – Promoting biodiversity conservation and ecosystem protection.

Section 4. Quality of the Learning Experience:

1. The program provides a dynamic and engaging learning environment.
2. Educational activities enhance students' critical thinking skills.
3. The program fosters collaboration and teamwork.
4. Interactive scientific exploration and research are encouraged.
5. The program offers equal learning opportunities for all students, regardless of background.

Section 5. Achieving Quality Education Outcomes:

1. Students demonstrate improvements in academic subjects such as science, technology, and mathematics.
2. The program fosters a passion for lifelong learning.
3. Activities broaden students' perspectives on global and local environmental issues.
4. The program enhances students' ability to develop innovative solutions to environmental problems.
5. Students acquire practical scientific skills applicable to real-life situations.

To verify the validity and reliability of the questionnaire, it was administered to a survey sample of 20 teachers. The internal consistency (Cronbach's Alpha) was calculated for each section of the questionnaire, and the results were as follows:

Table 2: Description of the Second Tool

Sections	Number of Items	Validity Coefficient
Students Awareness of Sustainable Development Goals.	4	0.76
Programs Impact on Sustainable Behaviours.	4	0.76
Achieving Specific Sustainable Development Goals.	4	0.88
Quality of the Education Experience.	5	0.87
Achieving Quality Education Outcomes.	5	0.91

All sections achieved a very good to excellent level of internal consistency (above 0.7), indicating that the questionnaire is reliable for measuring the specified objectives.

The reliability coefficient (Cronbach's Alpha) for all items combined as a single unit was 0.90, which is considered excellent and demonstrates a

high level of reliability and internal consistency among the items. Therefore, this questionnaire can be reliably used for its intended purpose.

Research Results:

First. The achievement of environmental citizen domains among students participating in the GLOBE program:

Table 3: Achievement of Environmental Citizen Domains Among Students Participating in the GLOBE Program Levels

Domain	Average Score	Severity Level
Knowledge	4.383333	High
Beliefs	4.7175	Very High
Behaviour	4.359167	High
Feelings	4.650833	Very High
Participation	4.262	High

The results in the table show a high impact of the GLOBE program on students' environmental citizen domains, this aligns with Al Balushi & Ambusaidi's (2022) study results.

Conclusions from the severity levels of domain achievement among students participating in the GLOBE program:

- Balance among domains: All domains have been achieved at "High" or "Very High" levels, indicating the overall effectiveness of the GLOBE program in improving various aspects related to environmental citizenship.
- Greater focus on knowledge and behavior: Although the domains have been achieved at good levels, working on enhancing environmental knowledge and behavior could further strengthen the positive impact of the program overall.
- Feelings and beliefs as motivators for behavior: The high levels of feelings and beliefs suggest that students are already prepared to

engage more actively in environmental activities if they are effectively guided.

Secondly. Statistical differences between participants and non-participants in the GLOBE program:

Table 4: Statistical Differences between Participants and Non-participants in the GLOBE Program

Domain	Mean- Not Participated	Mean- Participated	P- Value	Significance
Knowledge	4.041667	4.383333	1.39E-06	Statistically Significance
Beliefs	4.504167	4.7175	0.001448	Statistically Significance
Behaviour	3.9775	4.359167	1.88E-06	Statistically Significance
Feelings	4.375833	4.650833	5.32E-05	Statistically Significance
Participation	3.741	4.262	9.71E-08	Statistically Significance

* All domains showed statistically significant differences (p-value < 0.05) in favor of the participants in the program.

Interpretation: Participation in the GLOBE program positively impacts the achievement of the domains among students, as participants recorded higher averages across all domains compared to non-participants.

Thirdly. Statistical differences between males and females:

Table 5: Statistical Differences between Males and Females

Domain	Mean– Female	Mean– Male	P– Value	Significance
Knowledge	4.24866	4.086142	0.059261	Not Significance
Beliefs	4.650054	4.473783	0.029136	Statistically Significance
Behaviour	4.205788	4.037453	0.084147	Not Significance
Feelings	4.557878	4.357678	0.01504	Statistically Significance
Participation	4.028939	3.905618	0.302035	Not Significance

* Females demonstrate superiority in some domains (beliefs and feelings) compared to males, indicating that females may be more emotionally engaged and have stronger convictions about environmental issues.

Fourth. The perspective of GLOBE program teachers on the program's ability to achieve its related sustainable development goals:

Table 6: GLOBE Program Achievement of ItsSDGs

Sections	Average	Severity
Students Awareness of Sustainable Development Goals.	4.505319	Very Good
Programs Impact on Sustainable Behaviours.	4.542553	Very Good
Achieving Specific Sustainable Development Goals.	4.382979	Very Good
Quality of the Education Experience.	4.582979	Very Good
Achieving Quality Education Outcomes.	4.570213	Very Good

Based on the results in Table 6, most of the axes and items are rated as "Very Good", demonstrating the success of the GLOBE program in

achieving Sustainable Development Goals (SDGs) from the teachers' perspective. This indicates the program's efficiency and positive impact in meeting these goals. These results are in line with the findings of Qalhati et al. (2023) and Salame et al. (2020), who highlighted the program's capacity to cover multiple domains related to quality education elements.

Additionally, the analysis of Table 6 revealed that no items were identified as needing enhancement, based on the specified criteria. This suggests stable and high-quality performance across all axes of the program. This outcome corroborates the research by Al-Hadeede & Ambusaidi (2020), which also emphasized the program's effectiveness in achieving its objectives.

Results:

- Achievement of Environmental Citizenship Domains:

- All domains were achieved at High or Very High levels, confirming the effectiveness of the GLOBE program in fostering environmental citizenship.
- A stronger focus on knowledge and behaviour is recommended to further enhance the program's impact.
- Feelings and beliefs serve as key motivators, indicating that students are emotionally ready to engage in environmental activities if guided effectively.

- Comparison Between Participants and Non-Participants:

- Statistically significant differences ($p < 0.05$) were observed in all domains, favouring participants.
- Participants consistently scored higher across all environmental citizenship domains, reinforcing the program's positive influence.

- Gender-Based Differences:

- Females outperformed males in domains related to beliefs and feelings, suggesting a stronger emotional connection and commitment to environmental issues.

- Teachers' Perspectives on the GLOBE Program:

- The program received a "Very Good" rating for its role in achieving Sustainable Development Goals (SDGs), demonstrating its effectiveness.
- No specific weaknesses were identified, indicating consistent and high-quality performance across all aspects.

Recommendations:

- Enhance knowledge and behavioural engagement strengthen the knowledge and behavioural aspects of the GLOBE program by integrating more hands-on activities and real-world applications. This could include:
  - Advanced workshops on environmental monitoring and data analysis.
  - Fieldwork experiences that allow students to engage directly with environmental issues.
  - Interactive simulations that model environmental scenarios and solutions.
- Leverage emotional and belief-driven strengths by Utilizing students' strong emotional connections and environmental beliefs—particularly among female participants—to foster advocacy. Suggested initiatives include:
  - Establishing student-led leadership programs focused on promoting environmental sustainability.

- Organizing awareness campaigns and community engagement projects.
- Encouraging participation in international environmental forums and competitions.

- Conduct a detailed performance review while overall performance is strong, a detailed analysis at the participant level can help identify specific areas for improvement. This may involve:
  - Conducting targeted assessments to identify specific gaps in students' knowledge or engagement.
  - Providing tailored support and mentorship for students who require additional guidance.
  - Gathering feedback from participants to refine program content and delivery methods
- Expand program reach given the program's success, consider expanding its reach to maximize impact. This could involve:
  - Extending participation to additional schools or educational levels.
  - Developing partnerships with additional institutions to enhance program resources and support.
  - Exploring digital platforms to improve accessibility and foster greater engagement.

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