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Water Quality Citizen Scientist

Greening Education from University to Community

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Layout by :
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OVERVIEW

Implementing institution(s)	Faculty of Industrial Sciences and Technology, Universiti Malaysia Pahang Al-Sultan Abdullah (UMPSA)
Country and / or localities where practice has been implemented	Kuantan, Pahang in Malaysia
Timeline (first year of implementation - last year of implementation)	2025 – ongoing.
Target group	Local communities, school and university students, educators, and members of the public
Total cost incurred / Resources required	RM2000 / Resources included portable water quality test kits, sampling materials, printing materials, EM mudball preparation materials

INTRODUCTION

Water pollution and environmental degradation have become major concerns affecting urban recreational areas and local communities. However, public understanding of basic water quality parameters and environmental monitoring remains limited, especially among school students and local community members.

TVET institutions could function as the knowledge hub for regional environmental sustainability, disseminating academic researches and knowledge learnt in campus to create awareness in the local industries and neighbourhoods.

THE PRACTICE

Context

The community-based water quality education programme, “Citizen Scientist: Know Your Water Quality”, was introduced to bridge this gap by integrating greening education in campus with meaningful community engagement activities. University students applied the scientific knowledge and green skills learnt in campus, subsequently serve as facilitators and knowledge-transfer agents for the community.

The university to community approach encouraged collaborative learning between higher education institutions, local authorities, schools, and the public to address real environmental challenges collectively where Universiti Malaysia Pahang Al-Sultan Abdullah (UMPSA) coordinated the programme, developed the educational modules, and managed the scientific and community engagement activities. University students served as facilitators during field activities and assisted participants in conducting water quality testing and environmental monitoring exercises.

Majlis Bandaraya Kuantan supported the programme through local collaboration, logistical assistance, and facilitation of community engagement activities. Schools such as Regent International School participated in STEM-related environmental education and awareness programmes. The collaboration was further strengthened through a Letter of Intent (LOI) established between the involved parties

Aims

The programme aimed to empower participants with practical scientific knowledge while increasing awareness of environmental conservation, sustainable water management, and community responsibility towards protecting aquatic ecosystems. In addition, the programme supports the Sustainable Development Goals (SDGs), particularly SDG 4 (Quality Education), SDG 6 (Clean Water and Sanitation), and SDG 14 (Life Below Water), by encouraging active community participation in environmental stewardship through citizen science and experiential learning approaches.

Implementation of the Practice

The implementation of the practice was designed through several integrated phases to demonstrate the alignment between greening curriculum, greening research, and greening community initiative. The programme integrated classroom learning, applied environmental research, and community-based citizen science activities into a single experiential learning ecosystem. The overview of the implementation is shown in Figure 1.

Phase 1: Curriculum Integration and Student Capacity Development (Greening Curriculum)

The initiative functioned as an active-learning module embedded within the BSB3563 Bioremediation course at the Faculty of Industrial Sciences and Technology (FIST), UMPSA. Through this approach, students applied classroom and laboratory knowledge in real environmental settings while strengthening technical, communication, leadership, and community engagement skills. Students were trained in water quality analysis, environmental monitoring, preparation of Effective Microorganism (EM) mudballs, environmental sampling techniques, and scientific data interpretation. Students also prepared water sampling bottles and supporting materials during the training sessions, enabling them to engage in experiential and problem-based learning beyond conventional classroom teaching. This preparation ensured that students could guide participants effectively during field activities and community engagement sessions.

Phase 2: Applied Environmental Research and Bio-Based Innovation (Greening Research)

The programme also served as an applied research and development (R&D) testing platform for bio-based environmental solutions. Lecturers and students explored the use of Effective Microorganism (EM) mudballs developed from locally available organic waste materials as an eco-friendly and low-cost environmental remediation approach. The project supported the waste-to-wealth concept by transforming locally sourced organic waste into value-added environmental treatment products with potential applications in wastewater pre-treatment and pollutant reduction. The activity also strengthened ongoing UMPSA-related sustainability and environmental remediation initiatives involving water pollution management and nature-based environmental treatment technologies.

Phase 3: Community-Based Citizen Science and Environmental Engagement (Greening Community)

The programme contributed toward the greening community agenda by producing citizen scientists capable of transferring scientific and technical environmental knowledge from university laboratories to the wider public community. Through collaboration with schools, local communities, and local authorities, the programme strengthened UMPSA's role as a regional hub for environmental awareness, ecological resilience, and sustainable community practices. On the day of the implementation, the following activities were performed:

i. Pre- and Post-Programme Survey Evaluation

Participants completed surveys before and after the programme to assess their environmental awareness, water quality knowledge, and understanding of environmental sustainability issues. The surveys were used to assess improvements in participants' knowledge and to evaluate the effectiveness of the citizen science-based learning approach.

ii. Water Quality Briefing and Sampling Activities

Participants attended interactive learning sessions on basic water quality principles and environmental monitoring. The briefing covered important water quality parameters, including Biological Oxygen Demand (BOD), Chemical Oxygen Demand (COD), pH, and nutrients. Participants were also introduced to proper water sampling techniques and guided through sampling procedures at different sampling stations around the lake. The sampling bottles were made by the students during the training day.

iii. Hands-on Water Quality Testing

Participants conducted hands-on water-quality analyses using portable field-testing kits. The activities allowed participants to directly measure and observe environmental parameters in real-world settings. Participants worked in groups and recorded their own water quality results, encouraging active participation, scientific observation, and collaborative learning.

iv. Data Recording and Interpretation

Participants learned the importance of proper environmental data recording and interpretation during the monitoring activities. Facilitators guided participants in documenting observations and understanding the environmental significance of results from different locations. This activity strengthened participants' scientific literacy and understanding of environmental monitoring practices.

v. EM Mudball Making

Participants prepared Effective Microorganism (EM) mudballs as an eco-friendly environmental rehabilitation approach. The participants were introduced to nature-based solutions for water rehabilitation while promoting environmental responsibility and sustainable community practices. Participants were also allowed to take home mudballs as souvenirs.

vi. Symbolic Mudball Deployment and Community Engagement

Pre-prepared EM mudballs were symbolically deployed into the lake as part of the environmental awareness and community stewardship campaign. The activity served as a symbolic representation of the community's collective responsibility to protect water ecosystems and encouraged participants to continue environmental conservation practices beyond the programme. Participants (Figure 2) also received certificates and appreciation gifts as recognition of their involvement.

Figure 1 The overview of the programme

Figure 2 Participants of the programme

IMPACT

The programme introduced an innovative combination of citizen science and experiential learning approaches to improve environmental education and community engagement. While environmental awareness programmes and water quality campaigns have previously been conducted by various organizations, many are often limited to theoretical talks and minimal hands-on scientific involvement from participants. In this programme, participants were directly involved in hands-on water sampling, water quality testing, environmental data interpretation, and EM mudball preparation activities in real environmental settings. The programme also utilized low-cost portable water testing kits and community-based environmental mapping to make scientific monitoring more accessible to the public. In addition, the integration of eco-friendly bioremediation activities using EM mudballs exposed participants to sustainable environmental rehabilitation practices.

The programme demonstrated measurable improvement in participants' understanding of water-quality concepts and environmental monitoring practices. In the matched participant analysis, the average literacy score increased from 3.79 to 4.42 (5-point scale) after the programme, indicating positive short-term knowledge gains among participants (Figure 3).

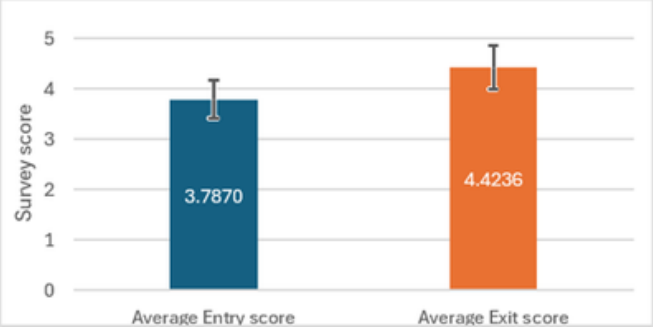

Figure 3: The average score for entry- and exit-survey (n = 19). (The error bars represent the standard deviation)

Participants also demonstrated strong awareness of proper water sampling procedures and environmental monitoring practices. More than 63% of respondents strongly agreed that improper sampling techniques can affect the accuracy of water-quality results, while more than 61% strongly agreed that water sampling should be conducted at different locations and depths to obtain accurate environmental data. The programme also increased awareness and practical understanding of EM mudballs as a community-based bioremediation approach. More than 55% of respondents strongly agreed that they understood the preparation and environmental function of EM mudballs in improving water quality.

In addition, field water-quality monitoring activities successfully exposed participants to real environmental conditions at different sampling locations around Taman Gelora (Figure 4), including variations in COD, BOD, ammonium, nitrate, and phosphate levels. Although pH values remained within acceptable Malaysian water quality standards (pH 7), the findings highlighted the need for improved water management and pollution control measures.

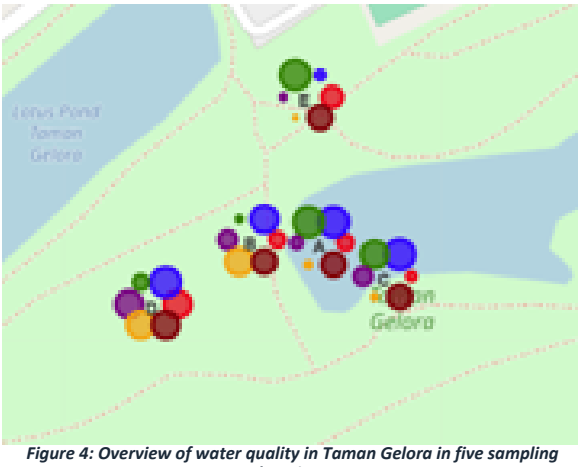

Figure 4: Overview of water quality in Taman Gelora in five sampling locations

Freshly prepared EM mudballs (Figure 5) appeared moist, compact, and dark brown, while fermented mudballs became drier and lighter after three weeks due to microbial activity. Fermentation promotes the growth of beneficial microorganisms, including lactic acid bacteria and yeast, essential for bioremediation. Matured mudballs gradually release microbes into aquatic systems, improving water quality and reducing organic pollutants

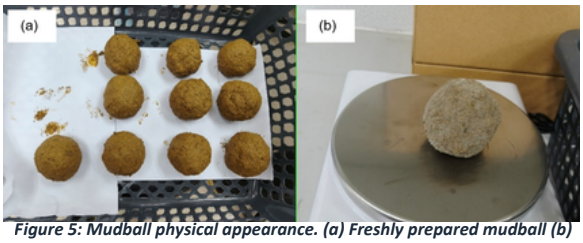

Figure 5: Mudball physical appearance. (a) Freshly prepared mudball (b) Mudball after 3 weeks fermentation

LESSON LEARNT

Generally, the Water Quality Citizen Scientist hands-on and experiential activities helped students connect scientific and environmental knowledge and skills learned in the university with real-world applications in the field, making the learning experience more meaningful.

The integration of citizen science within EM mudball research embedded in the bioremediation syllabus and curriculum successfully fostered water environmental awareness; introducing to the community a natural wastewater treatment.

The implementation of a successful university to community project would not be possible without strong collaboration between the university, local authorities, other schools, and the community, enabling access to environmental monitoring sites, basic testing equipment, and trained facilitators.

Other lessons learnt from the community implementation phase involved some participants experiencing difficulty understanding scientific terminology and the lengthy survey involving water sampling techniques and analysis involving pH, BOD (Biological Oxygen Demand) and COD (Chemical Oxygen Demand), nitrate, phosphate and ammonia particularly younger participants and those with non-science backgrounds. Limited programme duration and varying technical abilities may have also affected depth of participation and engagement.

Hence, future improvements include simplifying survey instruments, enhancing facilitator support, extending activity duration, and integrating digital monitoring tools.

REPLICABILITY AND FUTURE OUTLOOK

The Water Quality Citizen Scientist programme could be replicated by schools, universities, local authorities, and community organizations due to its low-cost, flexible, and community-based approach. Using portable water quality testing kits, simple sampling procedures, and hands-on environmental activities, the programme can be implemented in lakes, rivers, parks, coastal areas, or school environments without advanced laboratory facilities.

Additionally, the greening institutional framework that could be replicated to sustainably advance green transition initiatives:

- Greening the Curriculum: Embed the project as an active learning module within standard courses, integrating sustainable development goals as learning objectives
- Greening Research: Encourage experimentation, applied research and development in generic and industry-specific green skills
- Greening Communities: Students use citizen science to transfer their technical lab knowledge to the public, transforming the TVET institution into a regional hub for ecological resilience.

The Water Quality Citizen Scientist practice could be adapted to different educational levels and community settings, providing a scalable model for environmental literacy, experiential learning, and community engagement in sustainable water management.

CONCLUSION

The Water Quality Citizen Scientist programme implemented at UMPSA could be a source of inspiration for other institutions looking to implement Education for Sustainable Development (ESD) and Green TVET through greening the curriculum, greening research to greening community that meets international sustainability development goals (SDGs) and frameworks.

Green skills and education at institutions could be a catalyst to produce responsible citizens contributing as active members of the green economy for improved human well-being and social justice (International Labour Organization, 2021).

Using hands-on and low-cost environmental activities, the initiative demonstrates strong potential for future expansion into schools, communities, and sustainability programmes while supporting long-term green skills development and environmental stewardship.

REFERENCES

International Labour Organization. (2021). Greening guidelines for TVET institutes. https://www.ilo.org/publications/greening-guidelines-tvet-institutes

FURTHER INFORMATION

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ABOUT GOOD PRACTICES

"Good Practices" are chosen according to selection criteria that have been created by a working group. They aim to serve as benchmarks for transformation towards quality TVET.However, they reflect on the individual circumstances of the submitting country and may only be adopted with context specific modifications.

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