

13. Non-Formal and Formal Approaches to Science and Technology Education in Malawi

Dr Matthew Chilambo

*Chancellor College, University of Malawi, Zomba, Malawi
Umgeni Valley Environmental Centre*

The Umgeni Valley Environmental Centre near Howick in KwaZulu-Natal provides training in environmental education and produces curriculum materials for environmental education. AFCLIST sponsored a Malawi and Zanzibar delegation to a week's workshop at the Centre. During the week (6–13 December 1999) participants visited various environmental education facilities at Umgeni Valley and attended lectures as well as field trips to Treasure Beach Environmental Education Centre, Midmar Dam Environmental Education Centre and the Sea World Aquarium and Dolphinarium. During the week the proposal for developing environmental education nodes of excellence was completed. Malawi had just completed a project funded by the Rockefeller Foundation through AFCLIST. The following is a brief preview of the findings.

Malawi Environmental Education Project

Malawi's population was expected to be 12 million by the year 2000. With a population growth rate of 3.2 per cent, there is severe pressure on cultivatable land. As a result, environmental degradation is worsening every year. Conservation of natural resources requires strong measures and government efforts to curb degradation are hampered by a high level of environmental illiteracy. The Environmental Action Plan launched in June 1994, the Environmental Management Act of 1996 and the Forestry Act of 1996 are proof of government's concern for the environment. Within the Environmental Management Act environmental education features as one tool for combating illiteracy. NGOs such as the Geography Teachers Association run projects aimed at enhancing environmental education and natural resource conservation. This paper describes a project sponsored by the Rockefeller Foundation through AFCLIST, that demonstrates the effectiveness of environmental conservation by students in 25 secondary schools spread throughout the country.

Project objectives

The project's two main objectives were:

- ◆ To introduce interactive teaching-learning activities aimed at reducing environmental degradation by motivating students to work with the local community to analyse and deal with causes of specific environmental problems;
- ◆ To develop students' understanding of the importance of science and technology in environmental protection and instill positive attitudes towards the environment.

The problem

In spite of earlier efforts to integrate environmental education in the geography curriculum in Malawi, its teaching was handicapped because fieldwork topics and course work projects were too broad and did not focus on specific environmental issues. The project hoped to develop approaches that would be easier for teachers and students to implement using resources within their local environment.

Methodology

School sample

The project team consisted of members from Chancellor College, the Malawi Institute of Education, the National Commission for UNESCO, the Department of Environmental Affairs and selected secondary school teachers. The study drew on a representative sample of 25 schools with a varied geographical location in all three regions. Five were girls' schools, one was a boy's school and nineteen were co-educational. This ensured an adequate representation of girls in the study.

School orientation

The project team briefed geography teachers and their school heads at a workshop on the approaches they would use. For the project to be able to develop effective localised curriculum approaches and materials, it considered orientation necessary to:

- ◆ involve teachers as curriculum developers;
- ◆ expose teachers to a style of teaching through which they in turn would involve students and members of local communities as curriculum developers;
- ◆ deepen teachers' understanding and commitment to using local resources to demonstrate that geography can lead to an improvement of the quality of life of local communities.

During the workshop the project team particularly stressed a need for community participation, interaction between students, and the role of teachers in sensitising students and other teachers on the chosen environmental problems. The workshop assisted participants with activities such as:

- ◆ planning field surveys;
- ◆ guiding students' fieldwork and their relationship with the community;
- ◆ developing appropriate research tools, for example when analysing water;
- ◆ helping students to conduct environmental audits;
- ◆ ways students could raise community environmental awareness using methods such as drama and dance.

The project provided each school with a small grant (approximately US\$40) for basic equipment and negotiated with head teachers for their support in explaining the project to other students and teachers, monitoring progress, establishing relationships with the community and minimising transfer of project teachers. Schools agreed to conduct project activities during time allocated to geography, and if this proved inadequate, to conduct activities in out-of-school time such as weekends. Only 39 per cent of teachers reported that most project work was done during weekends.

The orientation workshop helped school heads and teachers to identify their school's environmental project. Thirteen chose to tackle deforestation. Three schools chose water for their case studies. Of these one decided to monitor water quality by collecting and testing samples from local sources. A second was concerned with water conservation and planned to construct a collecting tank to harvest rainwater. The third school studied the sources of water in their area. One school wished to establish fish farming, while six wanted to study human habitat degradation. Another school planned to rehabilitate a nearby mining area, and a further school chose to study the local threat to biodiversity.

Evaluation of the orientation workshop indicated that 97 per cent of participants expressed confidence in carrying out their project, 83 per cent considered that the orientation was very good and 59 per cent thought the guidelines were very good. Participants' main concern was that the project grant to schools would be inadequate.

Implementation of school case studies

Case studies involved students in identified local problems that required action. Students' action required a deeper understanding of the environmental

issues, required an understanding of how science and technology could contribute to their solution and that they develop ways to mobilise community resources. During implementation of the case studies, members of the project visited schools to monitor and assess their impact on their selected environmental issues. Students and teachers were given written questionnaires towards the end of the projects two-year cycle. In addition, the team graded students' written project reports. The media was involved to raise public awareness about the issues under study. As described below, this media coverage led to the project director's co-option to the national task force of the Cabinet Committee on Health and Environment.

Community involvement

One school, Providence Industrial Mission (PIM), involved six neighbouring villages in environmental activities. The project team observed healthy seedlings in villages and in school. Interestingly, village chiefs refused to consult the District Forestry Officer since they believed that trees along the river that they wanted to rehabilitate had been cut down with his authorisation, and that he received bribes from the timber sawyers that cut them down. As a result of the students' project, the community became so aware of the importance of reforestation that they donated sections of their farms on the banks of the river for tree planting. However, other schools such as St. Michael's Girls, Mlanda Girls and Ekwendeni Girls reported vandalism by the community in which seedlings were uprooted and goats and cattle grazed on the nurseries and areas where seedlings had been transplanted. In response, students from these schools negotiated with chiefs to let them conduct awareness campaigns where they used poems, songs and drama to highlight the issues.

Students from St. Mary's Girls Secondary School worked with villagers in Namalaka to survey water pollution and clean the surroundings of boreholes. Villagers and students collected bricks and sand to build an apron to drain excess water, and effectively sought assistance from Zomba Central Hospital in testing water samples and donating equipment. The Bottom Hospital in Lilongwe Old Town gave similar assistance to students at Bwaila Secondary School involved in a human habitat degradation project. Hospital staff gave the school masks and gloves to use when cleaning hospital drains during clean-up campaigns. The community in Masasa Township in Mzuzu worked with students at Mzuzu Secondary School to clear and rebuild drains, replanting grass on bare areas.

School projects on fish farming were disappointing. At Liwaladzi private secondary school, authorities had given students an old dam to clear and stock

with fish. On their visit the project team saw no fish. The proprietors had suspended the teacher involved in the project and had given the team erroneous information. Students at Ludzi Girls School had to change their project from fish farming to human habitat degradation after digging two dams since pumps promised by the school proprietors did not materialise. Mulunguzi Secondary School built an effective rainwater tank that enables savings to be made on the school's water bill.

Most seedlings in schools involved in tree planting wilted and died during the long vacation since no arrangements had been made for watering them when students were away. Students at Bandawe Secondary School actually cut down indigenous trees to clear an area for tree planting on the advice of the agriculture teacher and district forestry officer!

Written reports

Twenty-two of the 25 schools submitted written reports though teachers rather than students. Most reports had maps and photographs illustrating their activities. Students' maps showed that students can learn map-making skills as well as environmental concepts, skills and attitudes. Many schools used scientific skills to record and analyse data. For example, Ekwendeni Girls Secondary used tables and graphs to record the growth rate of trees. Those that did so reported the slow growth rate of many indigenous trees, stressed the importance of their conservation and reported on awareness campaigns that they conducted based on their observations. Some schools used various scientific tests to analyse water sources such as rivers, streams, springs, boreholes and taps. St. Mary's School identified and traced bacterial agents such as *escheria coli* and *salmonella* to water sources in Zomba, conducted surveys and interviewed inhabitants to map associated diseases, and communicated their findings to health authorities. Most schools designed and used technology tools, for example to construct water collection and storage tanks of make aprons round boreholes.

As schools implemented their projects, they learned much about topics such as the conditions necessary for growth, growth rates, ecology and interdependence, and the etiology and symptoms of disease.

Rewarding best school case studies

The project team administered questionnaires to students and teachers in the project schools. They used an observation schedule to check progress on school visits and to record evidence of community involvement. The team observers rated project activities from 0–15, evidence of community involvement from 0–15, student interaction with the environment from 0–5,

initiatives by teachers and school principals from 0–5 and completion of tasks from 0–10. The project administered a 20-item objective test to 5222 students in 23 of the 25 project schools. The items covered environmental concepts that students should have learned as a result of participating in the project. One question asked pupils to identify difficulties they had experienced in implementing their projects. Each member of the project team read all the school reports and marked them out of 50. Marks awarded were the average of the scores awarded by the five team members.

The project team used the teachers' questionnaire to determine their level of competence to teach environmental education through geography.

To motivate schools, the project announced that the best 10 schools would be awarded cash prizes. An additional motivation was that the best case studies would be edited and published in an environmental education teaching manual by the Geography Teachers' Association and distributed to participating schools free of charge.

Findings

Student performance

Scores on the objective test, together with those of the school reports, ranged from 45–75 per cent with a mean of 58 per cent and a standard deviation of 8. Overall 56.5 per cent of project schools were above and 53.5 per cent were below the mean.

On-site assessment

Scores on relevant project activity together with those for evidence of community involvement, student interaction, and teacher and principal initiative ranged from 3–77 per cent with a mean of 37 per cent and a standard deviation of 19. Forty-four per cent of schools were above average, 17 per cent were average and 39 per cent were below average. Three schools failed to implement their project because of teacher transfer.

Teacher competence

Twenty-eight teachers completed the questionnaire. Seventy-one per cent had learned about the project during the first year and 29 per cent during its second year. Forty-four per cent had attended the orientation workshop. Teacher drop out rates were substantial due to transfers.

All project school principals were aware of the project, though 25 per cent of teachers reported limited co-operation from them. All respondents reported that staff meetings had been held in schools to launch the project and that

other teachers knew about it. Seventy-five per cent reported working with lower classes to ensure continuity.

Thirty-nine per cent of teachers reported using only timetabled lessons, with 61 per cent stating that students also worked on their projects on weekends. However, 61 per cent thought that environmental education could be taught as any other topic in the geography syllabus.

Ninety-three per cent of teachers reported that they formed a project student committee to plan and manage the project, and 71 per cent held student briefing sessions shortly after the orientation workshop. Eighty-six per cent of teachers defined environmental education satisfactorily, and 90 per cent could articulate the objectives of their school projects. Though 96 per cent indicated that they could teach environmental education through geography, 64 per cent suggested that it was not easy to do so and 36 per cent claimed that they had difficulty doing so. Fifty per cent of project teachers recommended that environmental education should be taught through geography, 14 per cent recommended that it be taught through biology, while 36 per cent thought it was best taught as a separate subject.

Sixty-three per cent of project teachers thought environmental education complemented the school curriculum, and 89 per cent stated that it had raised student awareness on environmental issues considerably. Eighty-six per cent of teachers thought that students had shown a sense of ownership of their projects, 75 per cent said the project had contributed considerably to development of students' interpersonal skills and 85 per cent thought that to a great extent the project had helped students to feel a sense of control over environmental events. Eighty-three per cent were confident that the project had impacted positively on students and members of the community.

Classroom and school trials

The project team observed that implementation of the school case studies varied from poor to good. Three schools failed to implement their project due to transfer of their teachers. The best school, Ekwendeni Girls Secondary School, worked on afforestation of the school surroundings. They planted and monitored the growth rates of the indigenous trees and conducted awareness campaigns in the community. With assistance from the Central Hospital's laboratory, the second best school, St. Mary's Girls Secondary School, studied water quality at the Likangala, Bwaila and Namichimba rivers and boreholes in the municipality of Zomba. The third best school, Mlanda Girls Secondary School, also grew indigenous trees to rehabilitate the slopes of Mlanda Hill near the school. They cared for the trees and took measurements of the rate of

growth. The most poorly implemented case study demonstrated ignorance of environmental conservation. Students had cut down existing indigenous trees in order to plant new ones. When asked why, they admitted they were advised to do so by their agriculture teacher and the district forestry officer!

Lessons learned

Students in some pilot schools demonstrated that with minimum supervision they could interact with the environment, use the intellectual and analytical skills of science in their interaction and mobilise community members to conserve natural resources. The media was represented when the Minister of Education, Hon. Brown Mpinganjira and the Hon. Mayinga Mkandawire, Minister of Forestry, Fisheries and Environmental Affairs, gave prizes. *The Weekly News*, 1–3 September 1998, commented that the winners, the girls of Ekwendeni Secondary School, were proud of their trees. They had learned to care for them and appreciate their rate of growth. The editor further observed that the findings in Zomba by St. Mary's Girls that salmonella was present in the water drunk by some communities was an important and disturbing finding.

The project had less impact on teachers, some of whom were reluctant to implement the project since they saw it as additional to their normal classroom geography lessons. Teachers need orientation when environmental education activities are introduced to the curriculum. As important, enabling structures such as appropriate policy and examinations must be in place before most teachers are willing to adopt a case study approach to environmental education.

However, the project considered that the experience gained from its implementation demonstrated that with little input, secondary school students can engage in local environmental issues, becoming aware that school geography, science and technology can contribute to solving local problems, and that implementing effective solutions requires that they develop the interpersonal and political skills of community mobilisation.

The Way Forward

The project team, together with the editor of the *Malawi Geography Magazine*, edited the reports from the 10 best schools. These reports and the feedback from project schools formed a basis for developing and printing a teachers' resource manual for teaching environmental education through geography. It is the hope of the project team that the manual will help teachers and students learn how to conserve delicate and finite natural resources. The

young people of Malawi should learn to reduce, recycle and re-use – the 3Rs of environmental education. Teachers should be encouraged to use interactive teaching strategies.

As a result of media publicity for the project, the co-ordinator was co-opted as a member of the task force of the Cabinet Committee on Health and Environment. One of the committee's functions is to develop appropriate project proposals. The committee charged the project director with the task of drafting these proposals. They include a suggestion that funds should be allocated for printing more copies of the manual produced by the project. An unexpected outcome of the project, this illustrates that environmental education can empower not only individual students, and through them communities, but with appropriate strategies such as an appropriate and propitious use of the media, it can empower the nation through influencing policy.