Evidence of environmental education effectiveness

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ABSTRACT
There is continuous pressure on the South African education system to deliver graduates who can pursue careers in science and engineering. It is important to nurture a love for the environment and an understanding of the intricate processes that occur in nature, among young learners. This would increase the possibility that these youngsters would grow up to become environmentally-responsible adults, whether as parents, farmers, environmentalists, industrial managers or engineers.

A 2007 study in randomly-selected schools in the Buffalo (group B), Hartenbos and Klein Brak (group H) catchments determined how effectively State-of-Rivers (SoR) communication materials had been used in the education system of grades 1 to 3. Questionnaires and participatory evaluation techniques were used to determine the level of understanding of human impacts on rivers, both before learners had seen the materials and after exposure to materials.

The results indicate that, with the exception of a few schools, the supplied materials were mainly used to keep the learners busy. The learners in group H displayed a slight increase in their understanding of river ecology concepts over time. In rural areas, within group B, 50% of the schools showed a slight decrease in understanding, while the other 50% gained significant understanding, resulting in an overall increase in understanding in the target area.

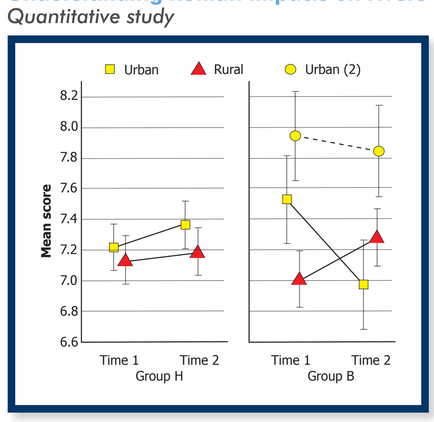
Ensuring optimum intervention in learners' understanding requires communication materials that are aligned more closely with the school curriculum, supported by closer work with the Department of Education to ensure the introduction of fundamental ecosystem learning. Better understanding of ecosystems empowers facilitators to add maximum value in the classroom.

METHOD
Study area: Buffalo, Hartenbos and Klein Brak catchments
Sample selection: Grade 1 - 3 learners from eight junior primary schools randomly selected from each catchment
Evaluations: Quantitative and qualitative assessments (open and closed questions); Questionnaire (n=1178) and participatory evaluations (n=261); before and after exposure to materials
Languages: English, isiXhosa, Afrikaans

Questionnaire measured learners':
- Knowledge of ecosystems
- Understanding of the benefits that healthy rivers provide
- Understanding of human impacts on rivers
- Attitude towards river conservation.

Participatory evaluations measured learners':
- Understanding of good and bad practices (indicated on a poster).

RESULTS AND DISCUSSION
Understanding human impacts on rivers
Quantitative study



All subgroups, with the exception of B Urban, showed an upward trend over time, indicating a slight increase in understanding due to SoR reporting materials. One school in subgroup B Urban was responsible for the decline in understanding. Omitting this school's results from the data resulted in a slight decrease in understanding for the B Urban subgroup (Urban 2).
(Cronbach alpha = 0.79 and 0.81 for time 1 and time 2, respectively)

Figure 1: Group, location and time RANOVA correlations, showing the results of a quantitative analysis to determine learners' understanding of human impacts on rivers ($p<0.01$). Vertical bars denote 0.95 confidence intervals

Qualitative study
Learners improved on the number of correct items chosen as representing what they think makes a river happy/healthy and sad/unhealthy. Learners' perceptions of both the negative impacts on rivers and possible mitigation actions were informed during the study period. Learners from rural areas showed the highest percentage improvement.

Table 1: Change in the number of correct items listed between time 1 and time 2 investigating learners' understanding of human impact on rivers (n=471)

Questions addressed	Number of correct items listed		% increase
	Time 1	Time 2	
What do you think makes a river happy?	398	537	29%
What do you think makes a river sad?	420	590	40%

Participatory evaluations
There was an overall increase in learners' understanding of good practices and the negative impacts of human activities on rivers. The rural subgroups showed higher increases in their scores over time, than the corresponding urban subgroups. Those learners that scored low (≤ 5) at time 1 showed the most improvement over time, especially in group B. Thus, those learners who knew the least at the start of the study, gained the most understanding of human impacts on rivers over time.

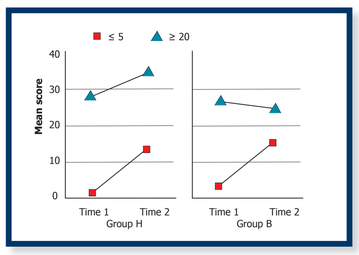


Figure 2: The relationship between time and initial score (≤ 5 and ≥ 20) as reflected by the participatory evaluations of groups H and B ($p < 0.01$)

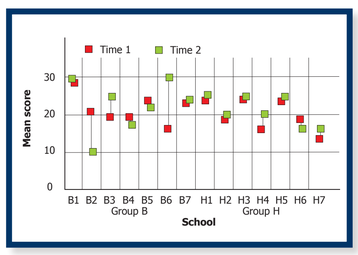
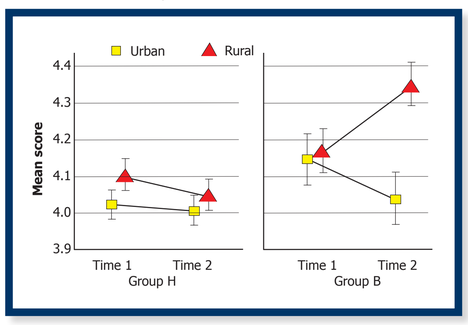


Figure 3: The change in learners' understanding of human impacts on rivers over time, expressed as a mean score per school

All schools in group H, with the exception of one, showed a slight increase in understanding of human impacts on rivers over time. Results from group B were more variable.

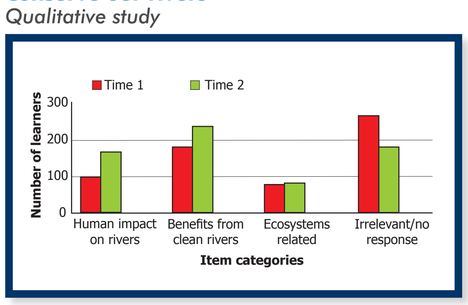
Understanding the benefits that healthy rivers provide
Quantitative study



Group B has a better understanding of the benefits that healthy rivers provide than group H. In both study areas, the rural subgroups showed a higher lever of understanding than the urban subgroups. Subgroup B Rural showed a significant increase in understanding over time ($p<0.01$).
(Cronbach alpha = 0.41 and 0.38 for time 1 and time 2, respectively)

Figure 4: RANOVA results indicating the differences in understanding of the benefits that healthy rivers provide amongst the groups and locations over time. For the subgroups B Urban n=96; B Rural n=136; H Urban n=283; H Rural n=248; $p<0.01$. Vertical bars show 0.95 confidence intervals

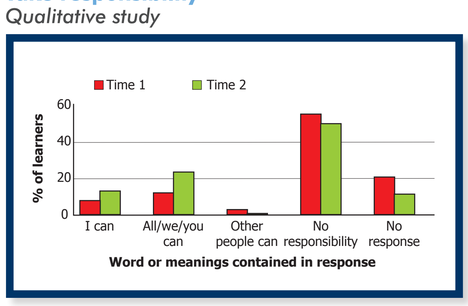
Conserve our rivers
Qualitative study



Question: Why should rivers be conserved/taken care of? Relative frequency of answers indicating:
- Human impact on rivers - increased
- Benefits from clean rivers - increased
- Ecosystem-related items - almost no change
- Irrelevant or no answer - decreased.

Figure 5: Comparison of four categories of responses to the question 'why should rivers be conserved?'. Data from the two phases of the study; (n = 582)

Take responsibility
Qualitative study



Question: What can you do to make sad rivers happy/ healthy rivers again? Proposed actions that could change unhealthy rivers to healthy rivers in descending order of greatest change between time 1 and time 2.

Figure 6: Relative frequency of responses to the question: 'What can you do to make sad rivers happy healthy rivers again?' allocating responsibility to the proposed actions; (n = 582)

Results from a study testing the effective use of State-of-Rivers communication materials in schools indicated that, although hampered by a lack of enthusiasm and creativity in the learning environment, learners from rural areas showed the greatest improvement in understanding.

Table 2: Items frequently listed as actions to be implemented to change unhealthy rivers to healthy rivers, in descending order of greatest change between times 1 and 2

Action	Time 1		Time 2	
	Frequency	Relative frequency	Frequency	Relative frequency
Litter removal	91	15.6	196	33.7
Remediation (clean up the rivers)	79	13.6	108	18.6
No littering	71	12.2	83	14.3
Protection of rivers	68	11.7	73	12.5
Protection of trees/plants and fish/animals	81	13.9	79	13.6

CONCLUSION, RECOMMENDATIONS AND FUTURE RESEARCH
- The understanding of the learners from rural areas within group B improved the most during the course of the study. This is likely due to the large number of households in this group that use rivers as their main source of domestic water. The degree to which the lack of piped water and sanitation and socio-economic circumstances in general influenced both the initial scores and the improvement in understanding, needs to be further investigated
- Those learners who knew the least at the start of the study, gained the most understanding of human impacts on rivers over time during this study
- The motivation and attitudes of teachers - as an influencing factor - is an important variable that was not foreseen and planned for in this study. Future studies should take into account and plan for this variable
- Environmental learning in schools, and the creativity with which it is done, also needs greater attention. The impact of environmental education on learners' environmental awareness, and the possibility of creating an environmentally responsible society, needs to be further investigated
- In South Africa, the foundation phase schools' curriculum currently focuses on water uses and water as a benefit to humans. The importance of functioning ecosystems and how humans can contribute to saving valuable natural resources, and looking after the environment in general, should be included and given the necessary substance in the curriculum. Facilitators' understanding of ecosystems and the importance of functioning ecosystems should be expanded
- Currently, the SoR materials target the foundation phase learners. SoR materials should be expanded beyond the foundation phase to encourage the forming of attitudes and behaviours that support sustainable development and a better future for all South Africans.

CP0-0031