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, industrialists or environmental policymakers.

A 2007 study in randomly selected schools in the Buffalo (group B), Hartenbos and Klein Bron (group H) catchments determined how effectively State-of-Rivers (SoR) 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 few schools, the supplied materials were mostly used to keep the learners busy and to present some knowledge concepts over time. In rural areas, within group B, 50% of the schools showed a slight decrease in 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 encourage 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 Bron catchments

**Sample selection:** Grades 1 – 3 learners from eight junior primary schools randomly selected from each catchment

**Evaluations:** Questionnaire and qualitative components (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 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**

<table>
<thead>
<tr>
<th>Group</th>
<th>Mean score</th>
<th>SD</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group U</td>
<td>4.4</td>
<td>1.4</td>
<td>*p &lt; 0.01</td>
</tr>
<tr>
<td>Group B</td>
<td>4.6</td>
<td>1.5</td>
<td>*p &lt; 0.01</td>
</tr>
<tr>
<td>Group H</td>
<td>4.5</td>
<td>1.4</td>
<td>*p &lt; 0.01</td>
</tr>
</tbody>
</table>

All subgroups, with the exception of Group B, showed an upward trend over time, indicating a slight increase in understanding due to SoR reporting materials. One school in subgroup B showed a downward trend in understanding. Omitting this school’s results from the data resulted in a slight decrease in understanding for the B Urban subgroup (Urban 2).

**Qualitative study**

Learners were asked 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 improvements.

**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)

<table>
<thead>
<tr>
<th>Question</th>
<th>Time 1</th>
<th>Time 2</th>
<th>Increase</th>
</tr>
</thead>
<tbody>
<tr>
<td>What do you think makes a river sad?</td>
<td>71</td>
<td>12.2</td>
<td>-58.8</td>
</tr>
<tr>
<td>What do you think makes a river happy?</td>
<td>398</td>
<td>537</td>
<td>34.0</td>
</tr>
<tr>
<td>What do you think makes a river healthy?</td>
<td>600</td>
<td>596</td>
<td>-0.6</td>
</tr>
</tbody>
</table>

**Figure 1:** Group, location and time RANDOVA correlations, showing the results of a quantitative analysis to determine learners’ understanding of human impact on rivers (p < 0.01). The 0.35 cutoff increases the sensitivity of the RANDOVA, and school’s results from the data are not shown.

**RESULTS AND DISCUSSION**

**Understanding healthy rivers provide benefits that healthy rivers provide amongst the groups and locations over time.**

<table>
<thead>
<tr>
<th>Group</th>
<th>Mean score</th>
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<td>1.4</td>
<td>*p &lt; 0.01</td>
</tr>
</tbody>
</table>

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.

**Quantitative study**

**Qualitative study**

**Figure 2:** the relationship between time 1 and initial score (≤ 5 and ≥ 20) as reflected by the participatory evaluations of groups H and B (p < 0.01)

**Table 2:** Items frequently listed as actions to be implemented to change unhealthy rivers to healthy rivers in descending order of greater change between time 1 and 2

<table>
<thead>
<tr>
<th>Action</th>
<th>Frequency</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Create dams to stop water from flowing into rivers</td>
<td>298</td>
<td>78</td>
<td>83.2%</td>
</tr>
<tr>
<td>Reduce pollution in rivers</td>
<td>600</td>
<td>600</td>
<td>100%</td>
</tr>
</tbody>
</table>

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

**Figure 4:** RANDOVA results indicating the differences in the understanding of human impacts on rivers over time. For the subgroup B Urban=86, B Rural=136; H Urban=282; H Rural=246; p=0.01. Vertical bars show 0.95 confidence intervals

**Table 3:**Items frequently listed as actions to be implemented to change unhealthy rivers to healthy rivers in descending order of greater change between time 1 and 2

**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)

**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)

**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 good water and sanitation and socioeconomic circumstances in general influenced both the initial scores and the improvement in understanding, needs to be further investigated.
- The results of the qualitative component indicate the most understanding of human impacts on rivers over time during this study.
- The understanding and attitude of learners towards an intervention is an important variable that was not foreseen and planned for 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 use 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 reflected in the curriculum.
- Enhancing the importance and the understanding of ecosystems and the importance of functioning ecosystems should be expanded.
- Currently, the SoR materials target the foundation phase learners. Soft 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.

**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.**

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**Evidence of environmental education effectiveness**