Promoting Spatial Thinking in Natural Resource Management through Community Mapping

Overview of the Innovation
This project was a pilot for the teaching of spatial thinking and aimed to empower young people with improved conceptual and geographic ICT (geo-ICT) technical skills. Teachers were trained in spatial thinking, geo-ICT, and mapping concepts. Students learnt geo-ICTs such as Global Positioning Systems (GPS) to map the local environment surrounding their schools. Spatial thinking curriculum created as part of the programme included reflection on environmental issues relevant to the geographical area of the schools. The project was implemented in upper secondary classrooms in two schools in Huye and Gisagara Districts.

A total number of 10 teachers and 147 were reached by the innovation.

Total budget was GBP 294,712.

Grant Recipient:
The project was managed by the Rochester Institute of Technology (RIT), a US University, in collaboration with the Centre for Geographic Information Systems and Remote Sensing (CGIS) at the University of Rwanda and the Rwanda Environmental Conservation Organization (RECOR).

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What makes it innovative?
This was the first initiative in Rwanda to have a specific focus on the acquisition of spatial thinking skills combined with student learning about community environmental issues.

The project was particularly innovative through its use of geo-ICT technology. It used open source application software and mapping applications which were new to the Rwandan context. The project took advantage of the wide mobile phone network coverage in Rwanda for operating geo-ICTs. Another innovative element is the ‘location of learning’. Students went out of their classroom into their communities with mobile devices to acquire and apply spatial thinking skills and at the same time learn about their local environment.

Relevance to education priorities;
Main Theme: Skills development;
Sub-theme: Appropriate technologies
The acquisition of spatial thinking and geo-ICT skills links with Goal 3 of the ESSP, to strengthen the relevance of education and training to the labour market, and specifically focuses on the need for transferable skills, such as communications, ICT, and problem solving. As spatial thinking is a skill developed through life-long learning, the project was also very relevant to ESSP Goal 1 of promoting educational access at all levels. The project’s strong emphasis on teacher geo-ICT skill and curriculum training also make the project relevant to ESSP Goal 2 of improving education and training quality.

Project learning (activity/output to outcomes level)
- The practice of ‘learning outside of the classroom’ adds a new element to learning and is very much appreciated by teachers and students. This makes the learning more relevant and contextualised, as teachers and students reflect on their own environment and the environmental issues within their geographical area.
- Teachers and students learnt how to interact with new technologies and the experience suggests they mastered the technologies relatively easily and quickly.
- The extra-curricular nature of the project activities and the reliance on time spent outside lessons brought challenges in teacher engagement and head teacher support for the project’s
activities.

- Although the project had a good focus on integrating new content in the school programme, it initially lacked sufficient emphasis on the methodological implications of this. At later stages of project implementation, teachers were provided with better support to be able to change their practices and 'teach in a different way'.
- The fact that RIT did not have on-the-ground presence in Rwanda had some negative impact on implementation at the early project stages that were overcome via low-cost communication and project monitoring technologies.
- Improving the experimental design to create comparable control and treatment populations would likely have strengthened the outcomes assessment reliability.
- Reliable internet connection availability was an issue.

Project outcomes and reflection on monitoring and evaluation

The evaluation has control and treatment schools evaluated at baseline and end-line but, with only a small number of schools, it is too small to be an experimental design. There are two measures of student learning outcomes: a spatial thinking ability test (STAT) and a concept mapping task. The former gives scores (and sub-scores) for different aspects of spatial thinking ability based on scientific literature. There was also a community mapping exercise to use the software to create a sample map (not a real map), graded in terms of the sophistication of the map representation.

Both treatment (2) and control (1) schools showed an increase in spatial thinking ability, though the percentage increase in score of the control school was higher than the other two (but the absolute score was lower). The GR claims differences among schools relate to their location (e.g. in forestry and agriculture areas). The GR also attributes the increases to dedicated teachers who remained vigilant with the project as, over time, project interaction became more challenging as the intervention was outside normal classroom activity. These explanations have limited data to support them. The concept mapping showed improvement in geo-ICT concept understanding at the two treatment schools (control school did not do it).

The pilot version of the innovation indicates potential but no strong conclusions can be drawn from the study for other schools in Rwanda. Although the spatial ability test is based on an international test with demonstrated reliability and validity, these have not been established for the Rwandan version. The concept mapping measure did have demonstrated validity and reliability.
Conditions for success

The successful implementation of this project was dependent upon the availability of the ICT equipment and access to the open software, and the necessary budget. This will be an even more pertinent scale up issue if existing plans for local production of tablets (and/or more cost-effective wholesale distribution) and nationwide free internet connectivity for schools are not realised, making the expanded project difficult to sustain. If the anticipated developments materialise, however, scale up immediately becomes a very feasible and cost-effective option.

The long-term impact of the project also depends on integration into the curriculum since it was revealed that the pilot project was mainly conducted outside of classroom time.

Scale up and sustainability considerations

The growth scenario presented by RIT covers 3 phases: (i) 10 schools, 40 teachers, (ii) 40 schools, 80 teachers, (iii) 100+ schools, 200+ teachers. The package is very similar to the pilot model and comprises: tablet technology with GPS; free open source software; hands on teacher training; student activities in the community. The idea of setting up ‘schools of excellence’ as part of the scale up model is new and has not been tested in the pilot. The potential impact of this remains to be seen and requires additional collection of evidence.

The next step of scale up foreseen by RIT is a realistic first step of adding 10 more schools. This makes sense, but also raises questions about systemic impact (10 schools is a very small number). It will be important to initially focus on schools that have some of the required equipment already. Bigger scale up is then only possible if country-wide connectivity and efficient access and distribution of computing hardware for educational purposes happen.

It would make sense to think about a scenario where RIT finds additional funding to run the next phase with 10 schools in ‘project mode’, using the time to gradually work towards a fully sustainable model, while supporting implementation of the new curriculum, building the capacity of REB and finding a solution to the major technology question. Wider adoption would come later after this further, larger scale trialling.

In terms of institutionalisation issues, the scale-up document raises some immediate concerns related to the current curriculum implementation process. The new GIS curriculum seems to have geo-ICT included, but the problem is that this may have a primary focus on implementing a GIS handbook and not address spatial thinking skills and educational learning outcomes at a higher level. The question is whether RIT involvement is too late to make any changes in this regard, or whether they can still make an impact through the curriculum implementation process.

Finally, there is a need for RIT and the GoR to discuss ways of transferring ownership and building the capacity of REB to sustain this innovation.
Cost Considerations
A low cost and high cost option for the immediate next phase are provided, both for 10 schools only. The high cost option will cost almost GBP 60,000 for initial scale up and the low cost option around GBP 15,000. The low cost option assumes available technology. Costs per school imply low-level scale-up is inevitable in the current financial context.

It would have been useful to have a full unit cost per teacher and per student for the low and high cost scenarios. The training costs should be part of these unit costs. Notably, the idea of creating schools of excellence is not reflected in the economic analysis but may actually have some impact on unit costs. There is clear cost-efficiency in the fact that the innovation uses free and open software.

There is a need for a more in-depth analysis of the longer term technology investment costs for the Ministry as their ability to invest in equipment seems to be critical to scale up this initiative. This analysis needs to take into account the impact of such investment on MINEDUC/REB budget. Additional arguments are needed to justify possible future investment in technology vis-à-vis low-technology alternatives. The availability of appropriate computing hardware at low cost to the education sector in Rwanda, as well as free internet connectivity for secondary schools, will offer greater opportunity for scale-up. Assessing what can be realistically expected of these technology options will be important.

Immediate Next Steps
• RIT and REB CMD, with advice from the TWG curriculum & materials, to discuss what options there are to have an impact on the curriculum implementation process, with a focus on teacher training and use of additional resources and content to implement the new curriculum.
• RIT to further analyse the options for making technology available at a larger scale and provide good justifications why the proposed use of technology indeed provides good value for money, and discuss this with the Ministry and relevant TWGs (TPD and curriculum & materials), ensuring a link with the Ministry’s ICT Masterplan.
• RIT to identify additional funding for the initial scale up to 10 schools and use the time of implementation to discuss with the Ministry and to identify a sustainable way of scaling up the innovation, owned and managed by REB and unblocking the current technology investment barriers.
• MINEDUC/REB as the Hub for Innovation to explore and broker possible relationships with private sector and NGO providers of ICT goods and services.