

# Open source GIS education resource

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*A "Gentle Introduction to GIS" – GIS in education in the Eastern Cape.*

In the Eastern Cape Province there are still many schools that are lacking computing infrastructure and teacher competencies in IT. In addition, access to the internet is extremely uncommon and most teachers lack access to even basic communications technology such as email. The province is very rural and many schools do not even have electricity, let alone computer equipment. Those schools that do have computer equipment are often using out of date hardware and software on these devices. Because of these issues, creating a successful programme for the tuition of GIS in schools is no easy task.

In 2008, Sindile Bidla (then of the Department of Land Affairs, Eastern Cape) put out a call for interested parties to submit proposals for the creation of an educational GIS resource based on open source software. The contract was awarded to Linfiniti Consulting and the project is funded and supported by the Office of the Premier, Eastern Cape.

In this article we describe the results of this work and the rationale behind the process.

## Why open source?

The DLA's call for proposals was a far sighted move to create an educational resource based on free and open source software (FOSS). A common meme amongst proprietary software vendors is the so called "crack cocaine" marketing approach. In this approach, vendors donate (or make available at very low cost) their software to educational institutions. This is the so called "first hit is free" step. Although superficially the act seems benevolent, they are creating an intellectual dependency on their software. When learners eventually leave schools and tertiary institutions, they will try to convince their employers to use the software that they are most

familiar with. The more adventurous may dabble in products from other vendors or in FOSS offerings, but the software they learned in their formative years will normally constitute their "fall back position".

Having a proprietary vendor's expensive software offering as the fall back position for knowledge workers in our economy is problematic. It creates an economic and intellectual dependency on a vendor based outside of our borders (since most proprietary GIS vendors are based abroad). While some may argue that an aversion to using products from foreign vendors constitutes "navel gazing", we argue that promoting FOSS fosters our local economic and intellectual development. FOSS software makes all of its users "first class citizens" in the intellectual playing field – since any user may delve into the inner workings of the software and modify it to their own needs. In addition, the open nature of FOSS creates an opportunity for local entrepreneurs to provide GIS solutions to businesses and government that are competitively priced – since they only need to charge for consulting services and not for the basic software itself. Since there is no net economic export in the result of such service delivery, the commerce generated from such transactions circulates within our local economy. As an added bonus, building local FOSS-based GIS expertise provides us with the ability to market these skills beyond our borders, creating an opportunity to build a net economic import based around South African GIS skills.

Against this background it was desirable to build a resource for building GIS skills in Eastern Cape learners that empowered them not only with GIS skills but also enabled them to move out of the education system with all

the resources they need to become role players within our economic and intellectual community. We followed the open source approach in the creation of this resource, making it truly open and accessible to all and with enough breadth and depth that it could be used in a self-help way, avoiding the need for poor schools to send their teachers on expensive training courses from proprietary vendors.

## The products

The aim of the project was to produce:

- A series of worksheets constituting an educational resource for teachers that introduces in a gentle manner the fundamental concepts of GIS.
- "Screencasts" - videos showing a walk through (via computer screen recordings) of the various concepts outlined in the worksheets to assist with recapping and practical application of knowledge gained from the worksheets.
- A branded, customised version of QGIS to accompany the resource.
- A dataset to accompany the tutorials.
- A website [1] where the resources mentioned above will be made freely available to the general public.

In keeping with the spirit of open source and open content, the products of this project were released under the Gnu Public License for Documentation (GPLD) for the worksheets, and the Creative Commons Share Alike licence (CC-BY-SA) for the screencasts.

These licences basically mean that the content can be freely shared and modified but the attribution to the original authors should be retained and any new products derived from this work should be released under the same licence as the original body of work. The terms promote a collaborative basis for future expansion of the resource.

## Worksheets

For consistency, the worksheets all follow a similar format (see Fig. 1). An initial header section provides the title for the topic and gives a one sentence overview of what will be covered. Important keywords relevant to the topic are also listed here.

Following the header section, the topic is introduced and then described in detailed but approachable language using illustrations to clarify concepts. Each topic ends with a topic summary which reinforces the concepts learned through the worksheet. After the summary, we make some suggestions to teachers on the kinds of learning activities that can be carried out with learners in order to apply this new knowledge in a practical way. The worksheets end with links to printed and online resources that educators can visit to obtain more information on the topic. Although we have provided QGIS with the educational resource, we have tried to keep the worksheets "application agnostic" as far as possible and rather focus on describing concepts. In contrast, the video screencasts are by their nature application specific and eschew the "concept only" based approach for a mixture of informative dialogue about the topic and a step-by-step procedural walk through of the activity being covered.

While we have tried to keep the terminology simple and the amount of jargon limited, this is balanced by the need to build the learner's knowledge. Each worksheet builds on the foundations of the previous worksheets to extend the learner's knowledge. The ten worksheets cover the following topics:

- Topic 1 introduces what a GIS is and provides an overview of the basic capabilities that a GIS application will usually offer.
- Topic 2 introduces vector data and how it can be used to represent real-world features.
- Topic 3 examines vector attribute data in detail and how they open a wide range of visualisation possibilities when combined with spatial information.
- Topic 4 describes how vector data are captured and the process of digitising is explained.
- Topic 5 introduces raster data and the key reasons as to why one may wish to use raster data rather than vector data in some situations.
- Topic 6 introduces the concept of topology in vector data and how

it may be used to ensure data consistency.

- Topic 7 covers coordinate reference systems in detail and describes why it is important to use an appropriate coordinate reference system for the task at hand.
- Topic 8 covers map production and describes the key elements that make up a useful and informative map.
- Topic 9 introduces the idea of spatial analysis in vector data by discussing buffer analysis.
- Topic 10 introduces raster spatial analysis by describing interpolation of vector data to produce a raster surface.

As you can imagine there are an endless number of additional topics that could be added – in planning the project we chose these ten topics since they provide a good overview of the subject area (GIS) while having the potential to be used to good effect in practical class projects and activities. The open nature of this content means that over time users of the resource can contribute additional topics, in so doing growing the amount of content.

### Screencasts

A series of screencasts were produced to accompany the worksheets (see Fig. 2). As we mentioned above, while



Fig. 1: The worksheets all follow a similar format.

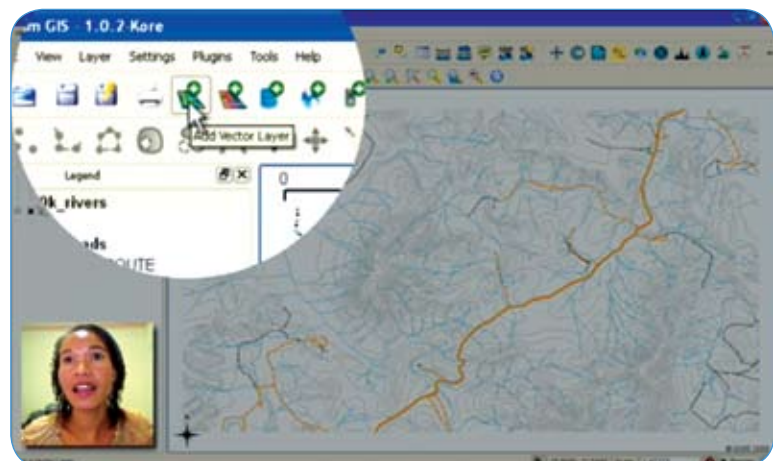


Fig. 2: Each video is narrated, with a video insert showing the narrator's face in a corner of the screen as the video plays.



Fig. 3: Training workshop for Geography subject advisors in the Eastern Cape.

the worksheets focus on conveying concepts, the screencasts are generally more focused on the practical application of these concepts. One self-imposed limitation of the project was that we wanted all the resources to fit onto a single CD. We chose CD as the principle delivery medium because many rural schools have old computer equipment (e.g. lacking DVD players) and we wanted to ensure that we made the resource available on the lowest common denominator that would work on as many school computers as possible. This obviously limited the size (file size and video resolution) of the screencasts we could produce. As such, we tried to limit each screencast to around 10 min. Using a 10 min cap on the length of the videos also means that we reduce the risk of the video content running beyond the attention span of viewers. Each video is narrated, with a video insert showing the narrator's face in a corner of the screen as the video plays. The main content area of the video consists of the QGIS application. As the narrator describes the procedures to follow, the video zooms in and out of the application to show, for example, a close up of an icon before it is clicked.

### Bundled software

Quantum GIS (QGIS) [2] was used as the basis for the educational resource. The fact that QGIS is open source, freely redistributable and user friendly made it a good choice for this project where we are seeking to disseminate the resource as widely as possible. As mentioned in our introduction above, there were ethical considerations that also motivated the choice of QGIS – we want kids to learn GIS on free software so that when they go out into the workplace

or higher education they are equipped with the best possible foundation on which to build our local skills base and economy. There were other benefits to using QGIS for this project – we were able to re-brand the software as the "Eastern Cape Edition", creating a sense of identity in the project that pervades into the software itself. Also, we created a customised installer that included all of the sample data used in the screencast exercises. QGIS also has a comprehensive user manual which is also under an open license and which was bundled with this educational resource, providing a migration path for learners who are curious to go beyond the skills they acquire in the ten worksheets.

The software shipped on the CDs is for Windows only – a reflection of the "on the ground" situation where Windows XP is pervasively used. For non-windows classrooms (QGIS runs on Linux and Mac OS X operating systems too) teachers can still use the educational resource but will need to obtain a copy of the sample data from the project website [1].

### Training

When planning the project, it was envisaged that the resource would be aimed primarily at teachers who would then formulate lesson plans from the materials and devolve their GIS knowledge down to learners. However we are also pragmatic and realise that many teachers, through time pressures, may simply pass the resource directly on to their learners. Before teachers are able to train learners in GIS, they themselves need to be trained. As part of the project strategy, training sessions will be held for teachers throughout the Eastern Cape so that they are familiar with the core concepts of GIS before attempting to pass the knowledge on to their learners. We emphasised the strategy of teaching concepts in the worksheets (as opposed to rote-learning) because we want teachers to be able to apply GIS generally as a teaching tool, as well as simply fulfilling the requirements of the curriculum to teach GIS.

The first training workshop was held in East London in September (2009) and was presented to Geography subject advisors in the Eastern Cape (see Fig. 3). Making curriculum advisors aware of the resource is an important step as they are in direct contact with the teachers. Further training sessions are planned in order to get teachers acquainted with the resource. The GIS department at the Office of the Premier, Eastern Cape is playing an important

role here as they lend their expertise and assist in the training sessions.

### Conclusion

In many contexts Africa, and to a lesser extent South Africa, are seen as global followers rather than global leaders when it comes to technology. Embracing open source and the philosophy of open content gives us a chance to shine and show the world what we are capable of. This project has been a good example of that. Since we have made the resource publicly available [1], the Eastern Cape has gained worldwide exposure for this work. At the time of writing, one of the screencasts has been downloaded over 30 000 times, and we have been contacted by, or made aware of various organisations around the world who are now making use of this resource – including a university in London.

The "Gentle Introduction to GIS" pack has also been included in the excellent FUNDISA disk, which has been created by the CSIR Satellite Applications Centre, a free resource containing a wide range of earth observation and vector data. The FUNDISA disk is being distributed to tertiary institutions around the country in an effort to promote and facilitate skills development in GIS and earth observation sciences.

Beyond the benefits of raising awareness around the world, the "Gentle Introduction to GIS" resource offers learners in the Eastern Cape something they never had before – a free GIS platform on which they can learn and, if they have the interest, delve into and acquire in-depth skills. We very much hope that other provinces in South Africa will take a look at what we have produced and that in the future we find out about people using this resource in new and interesting ways, even beyond the education system. More than that, we hope that the step that the Office of the Premier, Eastern Cape has taken to develop this resource will act as an example and encourage other provinces and organisations to follow their lead and build educational resources for a wide range of subjects in an open and collaborative way – and based on free and open source software!

### References

- [1] Website for the "Gentle Introduction to GIS": <http://linfinity.com/dla>
- [2] Quantum GIS website: <http://qgis.org>

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