Experience with the GIS Mobility Project at KOGEKA: An Example of Co-operation between Primary and Secondary Schools on School Mobility and Traffic Safety

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Abstract

The opportunities for using GIS in schools are numerous. KOGEKA, a community of six secondary schools in Belgium, has been working with GIS for about 10 years now and is running a GIS Mobility project in some of their schools. In this project the secondary school pupils work together with pupils from primary schools in the neighbourhood, on school mobility and traffic safety. This paper reports about KOGEKA's experiences with the GIS mobility project and describes (i) the added value that the use of GIS can offer in a project like this, (ii) how GIS can support the development of spatial thinking in pupils, (iii) what potential this kind of projects can have to contribute to achieve learning objectives described in curricula and (iv) how the project encourages pupils take up their role as active citizens. We conclude with some general thoughts to consider for schools that think of running similar projects.

1 Introduction: GIS, Travel and Safety in Schools

GIS is software based on a rapidly evolving technology, which provides a system of ordering, managing, manipulating and transforming information. Data can be combined, overlaid or integrated based on spatial location. GIS provides media-based visual representation of information and is a tool applied to solve 'real world' problems related to analysis, management and efficiency. It's validity in schools (HOGREBE 2012) and teacher education (ALIBRANDI & PALMER-MOLONY 2001) has been widely documented in terms of pedagogy (MILSON 2005), approach (KERSKI 2008), science (BAKER & WHITE 2003) and technology (KIDMAN & PALMER 2006).

The slow rate of adoption of this technology at the secondary school level has been attributed to a number of reasons including the lack of initial teacher training in GIS, language barriers, few opportunities for in service work, a scarcity of appropriate resources, data and materials and the fact that GIS software is perceived as too complex to install, too time-consuming to master and too expensive to purchase (IGUESS PROJECT 2009). Initiatives in GIS for secondary school education and related research in Europe have been extremely

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fragmented. Only recently through the digital-earth.eu project (http://www.digital-earth.eu) have centres offering their expertise to train teachers been identified, accredited and coordinated (DONERT 2013).

GIS is a tool commonly used in analysing transport, safety and travel plans (KIM and LEVINE 1996). Studies describing the use of GIS in travel and school safety issues are not common. NECKERMAN et al. (2009) used the walkability concept to examine neighbourhoods meanwhile ZHU and LEE (2008) created walkability measures around elementary schools. SHIPPS et al. (2012) developed a methodology to use community datasets to create whole school travel plans for more than 50 schools as part of the Safe Routes to School (SRTS) international movement to create safe, convenient and fun opportunities for children to bicycle and walk to and from schools. In teacher education, travel and safety research has mainly been developed from a human health perspective (FASKUNGER 2012) for instance to overcome obesity in youth (KERR et al. 2006). BRODIE (2006) describes how GIS was used to analyse significant volumes of data gathered as part of a school-wide travel survey commenting mainly on the success in mapping and presenting data. FAVIER and VAN DER SCHEE (2009) present an open-ended student research project on traffic accidents and local road safety characteristics.

KOGEKA is a group of six secondary schools in the rural municipalities of Geel and Kasterlee in the province of Antwerp, Flanders, Belgium. It totals more than 4400 pupils and almost 700 employees and has over 20 years of experience in European projects and internationalization initiatives. One GIS project developed within KOGEKA was based on the theme of 'mobility'. KOGEKA has worked together with some primary schools in the neighbourhood on the topic of traffic safety. In this project, our secondary school pupils help pupils from primary schools in the neighbourhood of our school to investigate dangerous traffic situations in the area of their home, their school and the surroundings. The pupils gather their own data and create digital maps in a GIS, analyse the problems with regards to traffic safety and brainstorm about possible solutions. With all the information they learn during the project they take up their role as active citizens and prepare a presentation to discuss the situation with the local authorities.

2 The GIS Mobility Project

2.1 Preparation

The GIS Mobility project was spearheaded by one of the KOGEKA schools, *Sancta Maria Instituut Kasterlee* (SMIK). In the preparatory phase of the project, a number of pupils from the first year of secondary education (age 12-14) *"the mentor pupils"* had to be made familiar with the concept of GIS and taught the necessary skills to use ArcGIS 9.3. The teachers that started up the GIS Mobility project were already experienced with GIS and the use of ArcGIS 9.3, due to their involvement in the previous projects described in the introduction. Teaching the pupils how to create the digital maps went remarkably well, with fewer problems to overcome than the teachers originally expected. Only after three 50-minute sessions of practicing, the first generation of *mentor pupils* was ready to teach the other pupils of the primary school how to create digital maps in ArcGIS, even though these pupils had never used the software, nor had they heard of GIS before. The last 50-minute

session was only a "repetition and reinforcement session" where the *mentor pupils* refined their skills in order to be able to work with the software more fluently.

After a successful one-year test run at SMIK in 2007-2008, the project was transferred to two other KOGEKA schools. The teachers of these schools had no experience with GIS. Therefore these teachers, volunteers, were invited to SMIK and attended a one afternoon workshop. Course material that was being developed at that time for the iGuess project was used for this workshop. After the workshop at SMIK, the teachers of the other schools then organized a few sessions in their own schools to prepare a group of pupils for their role as mentor pupils.

2.2 Course of the project

The project can be divided in 5 major steps. In a first preparatory step, the pupils of the primary school (age 10 -12) explored the area around their homes, the school and its surroundings. The fieldwork that was involved here was prepared by exploring the surroundings on paper maps first. The pupils indicated their homes, the school and the route they take when they come to school, on the paper map. All this work was done at the primary school. The pupils were guided through this phase by their own teachers. At this point there was no contact yet with pupils from the secondary school.

Pupils were challenged to ask basic spatial comparative questions, and discuss them with their peers, like:

- where is my school or home located relative to recognizable landmarks?
- where is my school located, compared to my home?
- is this distance further than the distance between landmark X and Y?

Next to the spatial questions, pupils also discussed issues which concern each of them individually, participating as active citizens in today's society, for example: when I participate in traffic if coming to school (most pupils are coming to school by bike), do I pass certain points where traffic could be particularly dangerous for me? Or, can I bring other people into danger by my actions, and where are the points of increased risk here? Where are these points located? What makes this point potentially dangerous? What could I do to increase my own safety, or my fellow citizens' safety, when I am coming to school?

In a second phase, the pupils of the primary schools were invited to the secondary school for an ArcGIS session. During these sessions, the primary school pupils worked in small groups. For each working group, a pupil of the secondary school was appointed as a mentor. With the assistance of their mentor pupil, the primary school pupils explored the area around their homes, the school and its surroundings again, but this time in a digital environment.

The possibility that GIS offers to overlay digital topographic maps with orthophotos enabled the pupils to make virtual walks through their neighbourhood, which offered them the opportunity to spend some time analysing the traffic situations at the potential dangerous points from a, literally, different perspective. In the course of this session, the primary school pupils drew their own digital maps in ArcGIS, based on the paper maps they prepared in their own schools with the help of their teachers.

Fig. 1: Pupils at work during ArcGIS session

In the next phase, pupils of the secondary school made a synthesis of all the maps of the primary school pupils and created one summary digital map. With this map, the pupils created their own "new" information, since spatial patterns emerged from these aggregate maps. Assisted by their teachers, the pupils could now start to identify and analyze the observed spatial patterns, they asked more advanced spatial questions and formulated corresponding hypotheses. The questions and hypotheses resulting from this analysis were used in the next phase of the project as the basis of the discussion with the pupils of the primary schools.

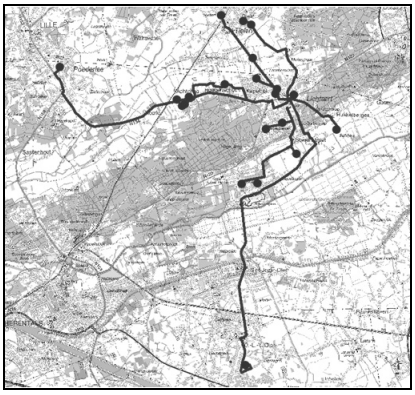

Fig. 2: Summary map of pupils' homes and roads taken to school (as produced by students)

Some examples of spatial questions were:

- what areas around the school do the pupils mainly come from?
- why do most pupils come from area X or Y?
- is there a "gap" in the area, a region where no pupils come from, and why is there this gap, is there another school located closer to that area?

- or is there an important influence of infrastructure, like a bus line passing through a certain area, leading to a better connectivity to another school, even if it is located further way?
- or is it just a demographic situation, e.g. a district that was parcelled out and homes built 15 or more years ago, so that children born in families that live there are already too old to go to primary school?
- what is the maximum distance that a pupil needs to (read: is prepared to) travel?
- how far is this distance compared to the average distance that other pupils travel?
- how far is this distance compared to the distance that I travel?
- are there significantly busy roads, which are used by a larger number of pupils, or significantly busy traffic points which a larger number of pupils pass by every day?

These questions appear to be closely related to the results of research undertaken by GERSCHMEHL and GERSCHMEHL (2006; 2007) that distinguishes a series of twelve distinct modes of spatial thinking and spatial cognition: location, site conditions, connections (situation), comparison, aura (influence), region, spatial hierarchy, transition, analogies (similarities), patterns, association (connections), spatial model and spatial exceptions.

Note: It is clear to see that also for the schools' own benefit, important observations can be done, and conclusions can be drawn, with regards to pupil recruitment strategies. The advantages of using GIS to school managers, head teachers for marketing and pupil recruitment has been indicated by BARTOSCHEK et al. (2007).

By summarizing the data of all pupils individually onto one map, the data was lifted from the level of the individual pupil, to an aggregate level of "the pupils of the neighbourhood" and society in general. This allowed pupils to start asking citizenship-related questions about traffic safety at the level of the community as a whole. Some examples of questions that relate to the role of the pupils as active citizens were:

- which are the traffic points that other pupils indicate as being dangerous as well?
- how many pupils indicate a certain spot as being dangerous?
- where are these traffic points located?
- what can we, as citizens, do to improve traffic safety at these traffic points?
- what could the authorities do to improve traffic safety at these traffic points?
- which is the authority that is responsible for these points?

In the fourth phase of the project, the secondary school pupils visited the primary schools and discussed the results and raised questions that could be asked about traffic safety that were prepared by the secondary school pupils in the previous step. The points of attention with regards to traffic safety were marked on the digital map and categorized based on a risk assessment. The points with the highest intrinsic danger for pupils, combined with the highest number of pupils passing there, were indicated as black spots.

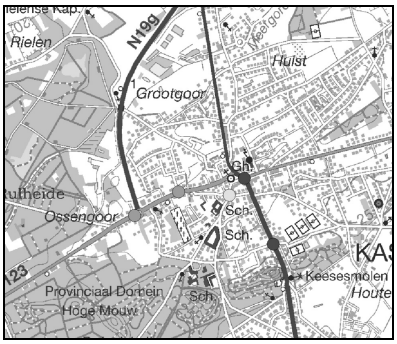

Fig. 3: Dangerous points, categorized in different shades of grey, according to risk (as produced by students)

Primary and secondary pupils together discussed about, and made an inventory of what exactly were the dangers at the different spots and brainstormed about possible solutions. They were able to share ideas about things they all could do individually to make it safer for themselves at certain points, but they also thought of initiatives that local authorities could, or should, take to improve traffic safety at these points.

In mutual consultation they listed the dangerous traffic situations they wanted to bring to the attention of to the local authorities, assessed which situations should be dealt with as the first priority, and prepared arguments they could use to support their demands. Together they went in the field and made the necessary pictures to illustrate the problems when it comes to traffic safety (FAVIER & VAN DER SCHEE 2009). Back in school the pupils linked these pictures to the points on the digital map and prepared a presentation for the authorities about their findings.

In the last phase eventually, the pupils of the primary and secondary school together presented their findings to the authorities concerned, whether or not in the presence of the (local) press. This step was optional and depended on the time that the primary schools could invest in the project, which in most cases was the limiting factor. We learnt from our experience that the authorities were in fact rather keen to participate in this step.

2.3 Learning objectives addressed

First of all, the content of the project addressed a number of general, and specific, learning objectives for both primary- and secondary school education from the Flemish curriculum. Furthermore, the project offered an important contribution to the cross-curricular research competences, formulated by the Flemish Ministry for Education and Training and that secondary school pupils need to have developed by the time they graduate from secondary school (VVKSO 2006). Based on this very clearly outlined project, the pupils worked through all three of the specific learning objectives that were described with regards to these research competences:

- pupils should be able to orient themselves in an area of research and gather, structure and edit data;
- pupils should be able to prepare, execute and evaluate a research activity;

- pupils should be able to report on the results and conclusions of the research and confront the latter with other opinions.

Table 1: Primary & secondary school learning objectives

Primary school learning objectives	**First two years of secondary school learning objectives**
Learning objectives: • Offering primary school pupils the opportunity to explore modern technologies (L.O.* 2.3 bis); • Offering carthographic skills (L.O. 6.1); • Increasing awareness of the pupils of traffic safety and –risks (L.O. 6.12). Specific ICT Learning Objectives (based on the diamond model): • pupils develop a positive attitude towards ICT and are prepared to use ICT as a learning tool (L.O. 1); • pupils can use ICT on a safe, justified and goal-oriented way (L.O. 2); • pupils can learn, and practice, independently in a ICT supported learning environment (L.O. 3 & 4); • pupils can use ICT to creatively mould their own ideas (L.O. 5); • pupils can use ICT to search, process and save digital information (L.O. 6); • pupils can use ICT to support a presentation of information (L.O. 7); • pupils can use ICT to communicate in a safe, justified and goal-oriented way (L.O. 8). It is important to add here that ICT is not regarded as a subject of its own, but should be integrated into other subjects.	Subject related learning objectives: Within the subject of geography, theme *Landscape and maps*: Starting from fieldwork, pupils have to (L.O. 1, 2 and 4): • use orthophotos and topographical maps; • measure distances on maps; • connect map scale with map content; • make a reference map of their own region, Belgium and Europe. Within the subject of Dutch language: Listening: • pupils can listen to a dialogue or polylogue in the context of the school or classgroup (L.O. 1); • pupils can listen to statements in a discussion with peers (L.O. 2); • pupils develop, in appropriate situations of communication, the willingness to (L.O. 4): o listen; o let the other speaker finish; o adopt an unbiased listening mentality; o compare other arguments and statements with their own knowledge, opinions and insights. Speaking: • pupils can (L.O. 5): o give instructions to known peers; o share information about a certain subject, theme or assignment with their peers and their teacher. • pupils can participate in a discussion with their peers and formulate and explain their point of view (L.O. 6) • in a situation of communication (see L.O. 4), pupils develop a willingness to (L.O. 8): o speak; o speak proper Dutch; o critically reflect on their communicative behaviour. Reading: • pupils can read schemes and tables (L.O. 9) Writing: • pupils can report about an assignment to a known adult (L.O. 15) • pupils develop a willingness to (L.O. 17): o write; o reflect on their own writing; o pay attention to language, structure, handwriting and layout. Specific ICT Learning Objectives (based on the diamond model): Primary school- and two years of secondary school, ICT Learning objectives completely overlap (see left column), except for two Learning competences which were additionally formulated for the first two years of secondary schools only: • pupils can, based on the goals envisaged, choose an appropriate ICT application (L.O. 9); • pupils are prepared to adjust their own way of operating after reflecting on the ICT use of themselves and others (L.O. 10).

(* The Dutch concept *Eindterm (E.T.)* is translated here as *Learning Objective (L.O.)*)
(VVKSO 2008, VVKSO 2009, VVKSO 2010)

3 Proceedings

Trapop, a primary school in Retie, took the project one step further. After the meeting and discussion with the local authorities concerning the traffic problems and dangers at the end of the project, they decided to do something more with it. Members of the school, the parents and pupils, sat together with the local authorities and the police and they worked out a school mobility plan, based on the findings of the school Mobility Project. They made an inventory of 'suggested' safe roads, for pupils to take when they come to school. On these roads, at certain points, road stewards were placed twice a day during rush hour, to help pupils cross the street. This was beneficial to both pupils and car drivers as it became safer for pupils to cross the street and traffic started moving more fluently. KOGEKA created and delivered the digital maps, indicating the suggested safe roads and places where the road stewards would be posted. All practical information and maps were gathered in a brochure. The municipality of Retie distributed this brochure a few days before the beginning of the next school year among the parents of all school children of Retie. With this initiative, the primary school of Retie won an important prize, including a cheque of € 5 000, from the *Foundation Koning Boudewijn* from this initiative.

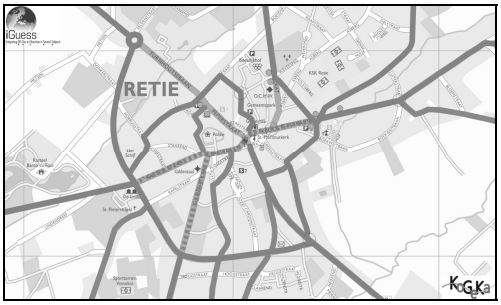

Fig. 4: Map with dangerous points, road stewards and suggested safe roads (as published in the brochure)

4 Findings and Conclusions

Our experiences with the GIS Mobility project have been, in many ways, very positive. First of all, this project offered the pupils to become involved in a setting in which they can unfold themselves and contribute to the common goal by taking up roles according to their own interests and talents. Because it was their "thing", they usually performed better than average in the roles they had taken up, which made them feel appreciated and proud of their own achievements, boosting their self-confidence. In some pupils we discovered unmistakable entrepreneurial talents, while others seemed to have it in them to be good mentors, or have very analytical minds, or be great speakers or writers, or even proved to be good philosophers.

By working together, pupils constantly practiced their communicative and social skills during the project. Several important learning objectives were addressed, both for primary as for secondary school pupils. For secondary school pupils the learning objectives

addressed could be cross-curricular as well as related to certain subjects. Important as well was the contribution of the project to cross-curricular research competences.

Last but not least pupils learned to work with GIS as a tool and using GIS increased their spatial awareness. GIS is already widely used in all sorts of businesses such as companies and public services, they are rapidly emerging in several aspects of society and still gaining importance (WHYATT et al. 2011) Pupils that have the necessary skills to work with GIS will be one step ahead and more able to succeed in future society.

For colleagues that might be considering to organise a similar project in their schools, we can conclude that young pupils deal remarkably well with using GIS as a tool. They learnt to handle the frames, toolbars, data layers and –tables with an ease that a good share of their teachers actually would, if at least they were honest enough to admit it, be jealous at. This brings us to the issue of getting teachers to work with GIS, or just to bring GIS in the school in the first place. It is a fact that many of the constraints defined by KERSKI (2003) still are there, but they are not irreconcilable. There are always possibilities and solutions if you want to look for them. The software is rather complex, but recent software versions are increasingly user friendly. Besides this, there are also GIS training opportunities, like the iGuess courses organised by EUROGEO (http://www.eurogeography.eu/iguess.html), to name just one. The software is costly, but developers have been working on affordable and even free solutions for education in recent times. Just approach them. There is also the option to use freely available open source software.

If GIS is not yet being used, the most important constraint, and probably the most difficult constraint to overcome, remains the lack of time that teachers have to learn to work with it, and to develop or identify and try out lesson materials to teach their students to use GIS. Starting up and running a project like this requires an important initial investment of time from the teachers involved. However, our experience shows that once the experience is there and the materials developed, the skills are quite easily transferred to other teachers and pupils. School policy makers should be aware of the investment in time it requires from their teachers and be prepared to provide teachers involved with enough opportunities and freedom to work on a GIS project like this.

In return, a project like GIS Mobility offers interesting learning and self-development experiences and opportunities for the pupils, as well as for the teachers involved. The work increases the spatial awareness of the people involved and gives the pupils the opportunity to become aware of, and to take up, their responsibilities as active citizens in today's society. As a bonus for the school, this project is an excellent opportunity to gain publicity and community awareness and to be able to profile itself (as a secondary school) towards possible feeder primary schools and their pupils in particular, and to the community in general, as an innovative and engaged school preparing their pupils for the hopes and the challenges as active citizens in today's and tomorrow's society.

The recent development of Cloud-based Web mapping applications (HUANG 2011), like ArcGIS Online for organisations, provides huge potential for the future by (i) removing the need to install and learn a software package, (ii) allowing collaboration between groups of students in real time (iii) increasing the opportunities to import other data sets, including real-time traffic flows for example and (iv) the ability to create presentations within the platform and instantly share interactive maps and information, either via the Web or the use of social networking.

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