

Mapping the surrounding environment by pupils. Case study: Primary school “Ismail Qemali” in Chair - Skopje

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Abstract: Cartography in primary schools in the Republic of North Macedonia is present as part of geography subject, for four years from sixth to ninth level, per two hours weekly. Program is limited only on usage of paper maps aimed for learning geospatial phenomena, without information for map making process.

Step forward toward increasing the awareness for including mapping in practical part of curricula in geography and other related subjects, are the activities undertaken by the Geo-SEE Institute from Skopje, by giving practical lectures to pupils in Primary School “Ismail Qemali” in Chair municipality, for usage the digital cartography tools via GIS software.

Training was designed to be used FOSS for GIS and open geospatial data by teachers and pupils. Field identification and collection of geospatial data based on ortho images and other base materials, as well usage of smart phones have been used as supplementary methodology for establishing geospatial database aimed for map compilation. Voluntary geographic information and crowd sourcing methodologies as opportunities for usage in teaching and learning process in primary schools not only for geography but for all subjects that intersects with geospatial information, were explained to attendees. Within very short period of one and half month, before pandemic on march 2020, pupils achieved to work with basic tools of QGIS software, as well to compile two maps, one geographical map of North Macedonia, and a map of neighbourhood “Topansko Pole (Fushë Topanë)” as city map of the settlement in which the primary school is located.

Keywords: Education on mapping, Children cartography, Map making

1. Introduction

Pupils need knowledge of natural, social, and technical areas to function today, while society expects that certain aspects of knowledge areas would be taught to pupils (Meadows 1979) in education process. The globalization trends make easier following latest technology and methodologies by teachers in order to use them for teaching pupils.

Natural, social and technical sciences, together with art, intersects in cartography, the science for compilation, production and using of cartographic products. Maps are a valuable bridge between the real world and the abstract world, can prepare pupils for better understanding graphs of math and scientific information, while mapmaking is useful for teaching the content of social studies and geography + developing a sense of place (Sobel 1998). Pupils books are such a great way for introducing new concepts to pupils.

A cartographer is someone who makes maps and charts to help people get information about a place [12]. Map skills are quite often taught in isolation rather than as part of a topic, which means that map skills are simply seen as a skill set, rather than to understand or to record information about places and features. Pupil-mapping is a

technique whereby a uniformly (Vanderbei 2005) usage and harmonization of art, natural and social sciences with technology. Maps are like pictures of where the geospatial objects and phenomena are arranged, that gives opportunities to pupils for orientation, environment observation and understand the space relationship between the spatial objects and phenomena.

Spatial thinking is one of the most important skills that students can develop as they learn geography, Earth, and environmental sciences, that allows students to comprehend and analyse phenomena related to the places and spaces around them—and at scales from what they can touch and see in a room or their neighbourhood to a world map or globe [1]. The ability to “read” a map, even a very simple one, is a skill that must be learned and can require considerable time and effort [2]. In a daily life, we use the spatial thinking methods and we understand the problems and we can easily find solutions for such problems. In this perspective maps are classifying in three titles: making a map, map reading and map interpreting (Kilinc 2011). Concept mapping provides a means for teachers and pupils to represent their understanding of an area of knowledge (Thomson 1997). Although nearly everyone acquires the basic map reading skills by the time, they have completed the primary grades, that does

not diminish the magnitude of these accomplishments for young learners [2]. The ability to interpret a map is a key life skill. Even in an age where GPS and Google maps play a greater and greater role, the ability to take information from a 2D image, whether that be on an "old school" sheet of paper or a mobile phone, and relate it to the world around is as important now as it has ever been [13]. Mapping can help pupils take better notes, improve comprehension and foster creativity. Exploring maps and atlases by young students in primary school can familiarize them with the varieties of maps available, and the terminology used therein [3].

Cartography at the beginning of twenty-first century is facing a technological revolution, which affects the technical frame of cartography, but it also changes decisively the relation between cartography and society [4]. Sharing knowledge with pupils for cartographic processes, well trained staff is needed in education institutions. Pupils are privileged by being familiarized with using electronic devices, and they can very easily convey the acquired skills from usage of computers, tablets, smart phones etc. to an effective map compilation. Many online mapping tools for teaching the map making for kids, such as ZeeMaps, National Geographic's MapMaker Interactive, Google Maps API, My maps, Snazzy Maps, Esri GeoInquires, Mapbox, Mapme, The national map, National Giant Maps, Ultimate globes, DIVA-GIS, QGIS etc. are available nowadays [5]. Beside them, as additional opportunity has to be considered Free and Open Source Software (FOSS) and Open Data (OD) that are available in internet also, for performing practical part of lectures by teachers.

Establishing the systematic usage of FOSS, OD and online applications in primary and secondary school education is one the objectives of Geo-SEE Institute, as promoter of adult education on GIS and SDI in North Macedonia. Due to absence of systematic way of using above mentioned opportunities in primary school education system in North Macedonia, initiatives for conducting pilot projects in order to increase the awareness among teachers aimed for dissemination impressions to responsible authorities in central and local level, are more than necessary.

2. Current conditions with map making in primary school curricula in North Macedonia

Cartography in primary schools in the Republic of North Macedonia is present as a part of geography subject, for four years from sixth to ninth level [6, 7, 8, 9], per two hours weekly. Program is limited only on usage of paper maps aimed for learning geospatial phenomena, without information for map making process. Practical exercises in this field are missing in geography books, as well as in curriculums for primary education in North Macedonia.

Although most of primary schools has computer rooms, geography teachers don't use them for using GIS software during theoretical and practical lectures concerning on map making and performing spatial analyses with pupils. It needs to be analysed why

younger teachers that have been degreed in geography after year 2000 don't use GIS software in teaching process, why responsible institutions didn't provide trainings for using GIS software to older teachers in systematic and organized process as lifelong learning programme, as well as the reason of not including GIS and other GeoICT tools in geography curricula's within the education process as obligatory practical exercises.

There are 8 reasons why GIS technology can enrich the educational process in school [10]:

- The learning materials will be easier to perceive, and learning much more fun;
- The functional literacy of students will be developed;
- Team working in and outside the classroom will be stimulated;
- Pupils will be divided into different cases and a variety of scenarios;
- Students' skills to ask the right questions and seek solutions to local and even global problems will be improved;
- Spatial and critical thinking of pupils will be developed;
- The world trends for multidisciplinary education will be applied; and
- Last but not least, by using constantly developing modern technologies, students will get an opportunity for working in a maximum modern learning environment.

3. Pilot project for education of pupils on map making processes by using GIS tools

Step forward toward increasing the awareness for including mapping in practical part of curricula in geography and other related subjects, are the activities undertaken by the Geo-SEE Institute from Skopje, by giving practical lectures to pupils in Primary School "Ismail Qemali" in Chair municipality, for usage the digital cartography tools via GIS software. It is first pilot project in North Macedonia, conducted in primary schools by training both sides, teachers and pupils [11].

Initiative for training on GIS software and map compilation started base on signed memorandum of understanding between the Geo-SEE Institute and the Primary School "Ismail Qemali", for organizing training course as additional practical exercises outside the time of regular lessons.

Training was designed according to the principle "train the trainers". From the teaching staff two geography and one IT teachers, while from pupils' side in total 16 students (per four pupils from sixth, seventh, eighth and ninth levels) attended to training. According to memorandum, pupils participants are obliged in coordination with teachers to transfer knowledge to other pupils in all classes in school, while teachers to continue with practical lectures in computer lab and field activities, until full implementing the geospatial technology in

everyday work by teachers and pupils in this primary school.

Team of experts of Geo-SEE Institute conducted training for one and half month in a period from January to March 2020, which stopped on March 11th because of the pandemic Covid 19.

In this pilot project, attendees became a beginner cartographer, as they compile maps that show natural features, political features, and/or economic information for the area of the case studies.

4. Training for map making with GIS software

Geo-SEE Institute team consisting of three experts Prof.Dr. Bashkim Idrizi (co-author of this manuscript), Doc.Dr. Subija Izeiroski and prof Driton Imeri, have been in charge of planning and realizing the training based on memorandum of understanding with primary school “Ismail Qemali” in Chair municipality in the city of Skopje. Responsible team of experts have designed curricula for special purposes for pupils of primary school without previous knowledge on GIS and map making, and later realized part of planned activities due to force stopped training because of pandemic Covid 19 on March 2020.

From the side of primary school “Ismail Qemali”, teacher of IT prof Neriman Selimi (co-author of this manuscript), and two geography teachers, prof Qamil Imeri and prof Nadi Sulejmani, have been participated in training, accompanied by 16 pupils per four pupils from sixth, seventh, eighth and ninth levels.

4.1 Designed curricula

The main objectives (Meadows 1979, Vanderbei and Traub 2005, Sobel 1997) of special purpose designed curricula by the Geo-SEE Institute staff for the pilot project are:

- Pupils have to understand map as model;
- Pupils have to understand and use the map legend;
- Pupils have to identify and explain natural and social features shown in map;
- Pupils have to be familiar with map orientation and using map for orientation and movement in a field;
- Pupils have to be familiar with vector and raster data formats in digital cartography and GIS;
- Pupils have to use GIS tools of FOSS for map making and performing spatial analyses;
- Pupils have to know downloading spatial data from open portals, and have to be familiar with the copyrights on open data;
- Sharing awareness importance of opportunities on contribution as VGI (Voluntary Geographic Information) by online editing and updating spatial data in open geoportals; and
- Pupils have to be familiar with usage of GIS applications in computer, tablets and smart phones for learning other subjects.

Before curricula designing, evaluation of current situation in target primary school “Ismail Qemali” with analyses of demand and supply have been conducted by our staff, in order to prepare strategy for performing training of pupils and teaching staff participants.

Based on above defined objectives and results from analyses of demands and supply, the special purpose curricula have been designed, with nine chapters.

1. Introduction on maps and map contents
2. Introduction on GIS and map making tools
3. Introduction on FOSS and OD with practical lessons for downloading and usage
4. Field identification and data acquisition with smart phone applications
5. Data editing in GIS software
6. Map compilation process and printing
7. Orientation and movement in a field with paper map and mobile maps by smart phones
8. Contributing to open geodatabases as VGI
9. Introduction to basics of crowd sourcing and geoportals / Spatial Data Infrastructures (SDI)

Implementing of above curricula contents is planned in a period of nine months, during one school year in duration per 2 school hours in a week.

4.2 Conducting training in period January – March 11th, 2020

Within the frame of designed curricula for this purpose, training with 19 attendees have been conducted by prof.dr. Bashkim Idrizi and prof Driton Imeri in period January to March 11th in the computer lab of primary school as direct beneficiary. Because of the time limitation, only about 30% of planned activities have been realized.

Basic lectures for introduction on mapping and GIS have been organized with all participants as one group, while for practical exercises attendees have been divided in two groups, first group with pupils from 6th and 7th level, and second group with pupils from 8th and 9th levels.

Source spatial data were downloaded from three sources:

- Open street map [15]
- SRTM [16]
- Global Map [17]

Open street map [15] was used for downloading vector data for the neighborhood “Topnasko Pole” where the primary school is located, SRTM [16] have been used for downloading the DEM (Digital Elevation Model) for the national area of North Macedonia with 30m spatial resolution, so from Global Map [17] the transportation, population centers, hydrography and boundaries as vector data were downloaded.

Each pupil created own account in open street map (OSM) portal and practiced for downloading and online data editing in OSM portal. From SRTM and Global Map portals, pupils and teachers learned how to download data for other countries and regions also, in order to use them in teaching process.

Since Geo-SEE Institute is certified organization by the Center for adult education and the Ministry for education and science for organizing official QGIS training courses in the Republic of North Macedonia [22], QGIS software [19] was used as platform for data editing and map compilation. All attendees downloaded and started using QGIS in computer lab PCs and their own lap top computers. Some of them installed mobile and tablet applications for usage in own smart phones and tablets.

In next figure, some photos from realized training lectures in computer lab are shown.

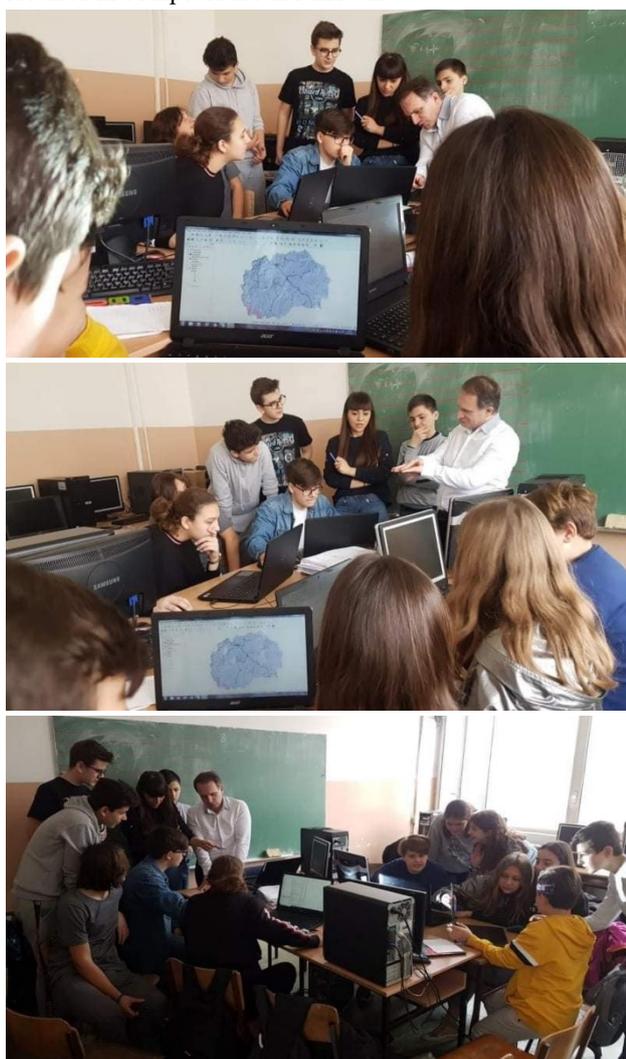


Figure 1. Photos from practical exercises in computer lab of primary school “Ismail Qemali” in Chair – Skopje [11]

Practical part of training for first group of pupils from 6th and 7th degree was focused on compilation map of North Macedonia with downloaded data from Global Map and SRTM, while second group compiled a map of the neighborhood where the primary school is located based on downloaded OSM data and field identification for updating OSM data. First group had to use only selected data according to the map theme, which means indirectly they learned how to generalize by eliminating not necessary data, symbolize selected data, adding map

essentials [20] and compilation map in layout, without need for supplementary data editing and field activities. Second group of pupils from 8th and 9th level was in charge to check downloaded OSM data with field identification by using printed maps and mobile applications, to be used for data editing in QGIS, than eliminating not necessary data, symbolizing, adding map essentials and preparing map for printing in layout, as well as updating OSM data with the changes that were recognized during field identification. Practical part was organized in such way given that younger pupils to get skills for editing data in QGIS software and to compile map with combining of already downloaded source data, while older pupils additionally to have skills for editing data in open geoportals as OSM, performing field identification, as well as to update the source data with the changes identified in a field.

4.3 Cartographic products from performed training

Within very short period of two months, pupils achieved to work with basic tools of QGIS software, as well to compile two maps, one geographical map of North Macedonia by first group of pupils, and a map of neighbourhood “Topansko Pole (Fushë Topanë)” as city map of the settlement in which the primary school is located by second group of pupils. Both maps are compiled and published in Albanian language.

Geographical map of North Macedonia covers entire national area with basic contents for state border, cities, national roads, railways, airports, lakes, rivers and relief, followed by map essentials, compiled in scale 1:250.000, in A0 format, and in international map projection UTM. Features were symbolized by customizing QGIS symbols from its library, without creating new symbols by pupils. In figure 2 compiled map is given.

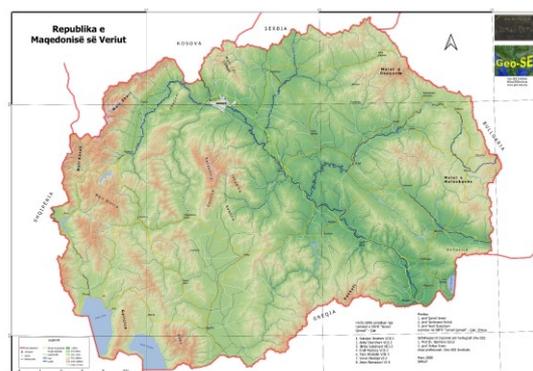


Figure 2. Map of the Republic of North Macedonia compiled by pupils of 6th and 7th grade [11]

City map of neighbourhood “Topansko Pole (Fushë Topanë)” cover area of about 40 hectares (0.4km²), printed in scale 1:11.000 in format A0, in coordinate reference system “EPSG 6316” which is in official use in geoportals of national mapping organization of North Macedonia, with length of about 1.1km and width of about 0.4km. Map contain 26 features classes with

separate symbols, created as new symbols by pupils in QGIS style manager. In next figure 3, compiled map of “Fushë Topanë” is shown.



Figure 3. Map of the neighbourhood “Fushë Topanë” compiled by pupils of 8th and 9th grade [11]

4.4 Updating OSM database by pupils

After field identification process, pupils of second group have identified all differences between OSM data [15] and the current situation in a field. Since all pupils created their own accounts with right to edit and add data in OSM, all identified differences have been edited and all new objects have been added as new features. With this, our pupils of primary school started voluntary contribution on developing open spatial datasets.

5. Presentation and dissemination of training results

Both compiled maps as first results of performed training with completed about 30% of planned activities in designed special purpose curricula for this pilot project, have been officially published and presented by Geo-SEE Institute representatives, teachers involved in project and pupils, in front of pupils parents on March 7th 2020 during the ceremony of celebrating the Albanian teachers day in primary school “Ismail Qemali”.

Information for training and both maps have been published in the primary school’s web portal [11] and the

Geo-SEE Institutes media with the moto “The team of Geo-SEE Institute is focused on dissemination knowledge among young students” [21]. In next figure, pictures from the presentation on March 7th, 2020 are shown.



Figure 4. Presentation of first results from on March 7th, 2020 during the celebration of Albanian teachers’ day in primary school “Ismail Qemali” [11, 21]

6. Conclusions

In the era of globalization and digitalization, usage of digital technology should be one of priorities in curriculums for primary schools. In this line, using geospatial technology must be implemented for practical exercises in geography and other related subjects.

Using GIS tools and open data gives opportunities to teachers and pupils for performing spatial analyses of natural and social data, that can be presented as reports, charts or maps as outputs of practical lectures. Using electronic devices as smart phones and tablets in practical part of lectures for learning the spatial phenomena, could motivate pupils exploring on more opportunities for using applications in function of learning and investigation.

Such system can enrich the educational process and will improve skills for critical thinking and multidisciplinary analyses in contemporary learning environment.

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