Mapping Space Through Sounds and Noises – An Innovative Approach for Geography Education

Jérôme Staub, Eric Sanchez

Mapping Space Through Sounds and Noises – An Innovative Approach for Geography Education

Jérôme STAUB and Eric SANCHEZ

Abstract

This paper aims at describing different school projects pertaining to noise and sound recordings for spatial analysis, in France. Students, from primary to upper secondary school, used location-based mobile devices such as tablets and smartphones to record data during fieldwork courses and to map their localities. The projects address the issues of (1) the relationship between the body and a nearby space for primary students and secondary students and (2) the question of *soundscapes* (SCHAFFER 1992), *i.e* an acoustic environment by which we hear the full set of sounds of the space where we are, as a basis for the analysis of urban spaces. These experiments allow a better understanding of space navigation for individuals and space modeling with visual and symbolic data. In this paper, we also address the question of the effectiveness of location-based mobile devices for educational purposes. Moreover, these experiments offer new perspectives for spatial analysis within an educational context.

1 Introduction and Background

Mapping space through sound and noises may seem paradoxical. Indeed, a map is a visual representation of the world that usually does not involve hearing. Mapping consists in imposing the order of a possible interpretation on the disorder of the world (LUSSAULT 1996). It also consists of modeling and reducing the complexity of reality for the sake of intelligibility. On the other hand, listening to sounds, recording sounds and restoring a sound environment all aim at grasping the complexity of reality. As a result, according to Attali, mapping sounds and noises is essential to understanding the world: "Nothing essential happens without noise being made manifest" (ATTALI 2001).

The validity of this approach refers to the definition of the relationships between human beings and their surrounding space: "human spatiality consists in organizing living space by using space-resources" (LUSSAULT 2007). This concept of habitat implies a form of spatial appropriation. As a result, for a student, the first appreciation of space refers to his body, its location, linked to the sensations gathered by his senses, including hearing. Thus, "the ear becomes attentive and looks for the marker that enables one to locate one's body in space" (MARIETAN 2005).

In the following, we describe different French school projects pertaining to the use of *soundscape* – *i.e.* an acoustic environment by which we hear the full set of sounds from the space where we are (SCHAFFER 1992) – for educational purposes and we address the fol-

Jekel, T., Car, A., Strobl, J. & Griesebner, G. (Eds.) (2012): GI_Forum 2012: Geovizualisation, Society and Learning. © Herbert Wichmann Verlag, VDE VERLAG GMBH, Berlin/Offenbach. ISBN 978-3-87907-521-8.

lowing questions: what is the value of sound and noise mapping for spatial analysis within an educational context? Which tools can be used for such a project?

1.1 Fieldwork as a pedagogical approach

The effectiveness of fieldwork for educational purposes has become a widespread idea. In his book, *Seven Complex Lessons in Education for the Future*, MORIN (2000) underlines the importance of context for understanding complex concepts. The advantages of such a pedagogical approach have often been underlined. According to a review of literature conducted by Kent & al. (KENT et al. 1997), fieldwork is now commonly accepted as a process that allows for the integration of theoretical and practical concepts and encourages a complete and all-round understanding of geographical ideas.

However, a large study conducted in France (SANCHEZ et al. 2005) demonstrates that students do not fully benefit from the opportunities offered by field trips. For different reasons, pertaining to the way the teachers organize fieldwork, they are more likely to be involved in an open-air lecture than in a situation that allows students to carry out a scientific inquiry and to develop technical skills.

Nowadays, digital technologies offer the opportunity to renovate the way fieldwork is organized. They can transform the learning process by offering the teacher the opportunity to imagine innovative learning activities in order to implement an Inquiry-Based learning approach. According to this view, geotechnologies and location-based mobile devices can help students be involved in autonomous learning activities by assisting them during the entirety of the inquiry process (SANCHEZ 2008, 2009). In this context, students are considered to be *produsers*, *i.e* both involved in using and producing information. In our experiments, digital mobile devices take an important role in the design of the learning situations.

1.2 Soundscapes as a basis for spatial analysis

Listening to and recording sounds to improve the understanding of territory is not usual, as the primary sense used for geographic analysis is sight. Indeed, according to a Platonic view, sight is the main way to apprehend the world (DROIT 2009). Nevertheless, our environment is not limited to visible electromagnetic information and not taking other data into account would result in a reductionist approach. Thus, sound and noise can carry important information regarding what is happening in our surroundings. For example, a hidden object falling can be heard but not seen.

The term “soundscape” refers to the idea of collecting georeferenced sounds. As mentioned by Schaffer, “We needed a term to define our studies, and that's when the word soundscape came into vocabulary. It comes from the landscape. The landscape is neither more nor less everything that can be seen and the soundscape has become everything that can be heard.” (SCHAFFER 2010). Another definition includes the spatial dimension: “I call the acoustic environment the soundscape, by which I mean the total field of sounds wherever we are.” (SCHAFFER 1992). The various experiments that have been conducted as a part of the World Soundscape Project and elsewhere have gradually entered the field of geographic inquiry. This interest for soundscapes is linked to different geographical work, where inhabited space becomes an object of study. FRÉMONT (1976) shows how the concept of the region, so difficult to define with globalization, can find its geographic reality in a subjective and sensitive approach to its relationships with human beings:

> We must admit, considering the structure of the region as a special system of relationships linking people and places in a specific area and that geography is the study of these relationships, that light must be put on them. But a human being is not a neutral object within the region, despite what one might think[…]. He gains space evenly around him, he makes judgments on the premises, he is retained or attracted, consciously or unconsciously [...]. From the man in the region and the region to the man, the transparency of rationality is blurred by the inertia of habits and impulses of affectivity, packaging of culture, the fantasies of the unconscious. Inhabited space, throughout its thickness and complexity, appears as the developer of regional realities.[...]

This conception of space is close to the notion of “Thirdspace” developed by Edward Soja, in reference to Henri Lefebvre. It is one part of Soja’s tripartite division of space: “If Firstplace is explored primarily through its readable texts and contexts, and Secondplace through its prevailing representational discourse, then the exploration of Thirdspace must be additionally guided by some form of potentially emancipatory *praxis,* the translation of knowledge into action in a conscious – and consciously spatial – effort to improve the world in some significant way” (SOJA 1996).

In order to understand inhabited space, it is necessary to address the various perceptions of it with our five senses. This sensitive and subjective geography models space with soundscapes in order to address geographical problems. Thus, RODAWAY (1994), discusses the term soundscape: “The key merit of Schaffer’s vocabulary is simplicity. This is also its limitation. It combines a redefinition of existing terms borrowed from various sources and the invention of new terms. Though Schaffer himself is a musician and composer, his terminology is heavily reliant on visual metaphors”. He replaces the term by *auditory geographies*.

Various tests have been conducted, with a particular emphasis on sound effects (AUGOYARD & TORGUE 1998). An example of a map derived from a sounds is described by KRIEGER (1994). Nowadays, digital web mapping tools considerably enhance the possibility to represent sounds and effects, including the possibility to introduce multimedia elements (CHÉTELAT 2009).

Starting with this point, we consider that it is relevant to use sounds and noises for territory mapping and the analysis of space within an educational context. Then, the question addressed to teachers is how to record and keep track of sounds and noises in order to design a *soundscape* as a specific model of a given territory? How does one collect data during fieldwork in order to design a map? Our approach consists in using mobile devices that combine the possibility to record sounds (digital recorder function) and to locate the collected data (GPS function). Such devices are now widespread. They are called smartphones and digital tablets.

1.3 Research question and methodology

Our research questions relate to the impact of the design of soundscapes on the learning process. How does the design of soundscapes change the way one discovers and understands space and territory in school? What is the added value of such an approach for geography education?

Our research methodology was based on the confrontation of an a priori analysis of the learning design – based on our theoretical framework – and the results of implementation of this learning design with the students (ARTIGUE 1996, BROWN 1992). This methodology intended to stimulate reflective practice and to capture the implicit knowledge that was used to design the learning situations. It aimed at improving educational practices through iterative analysis, design, development, and implementation (WANG & HANNAFIN 2005). We were at the preliminary steps of an explorative research project.

Different experiments have been carried out in primary and secondary schools with the same educational framework: the use of soundscapes for geography education. Primary school students used soundscapes to discover body orientation and simple spatial references. Lower secondary students were involved in a diachronic analysis of soundscapes of their school. Thus, they discovered themselves as major noise producers. Upper secondary students addressed the problems of their nearby urban spaces regarding noises and sounds collected during field trips.

2 Three Experiments about Soundscape in Geography Education

2.1 Discovering the nearby space at primary school

A first experiment involved 6-7 year-old students who were just beginning to learn reading and writing. Students moved to a given neighborhood space and, for each main building, they listened to background noises and tried to distinguish the intensity and the direction of each noise. Students possess skills to use space tracks and spatial vocabulary linked to their body (left-right, front-back). For one hour, they identified buildings and they designed a soundscape by listening and recording. This activity consisted of a journey through the city and a visit to four buildings: the school, the church, the town hall and the post office. Students were provided with the aerial images copied and pasted from Google Earth and a simple plan with located places for listening to sounds. At each stage, students were asked to locate themselves around the building and to identify their relative position. Then, for a few minutes, they listened to background noises and, as they were not yet able to write, they drew a picture of these sounds. They used an arrow to indicate the direction of the sounds and noises they heard. The arrow length depended on the intensity of the noise. During the course, a student was responsible for monitoring the progress of the students on a smartphone using the *My Tracks* application. This student indicated to other students the most direct way to proceed. He was responsible for the group and it was a difficult task because of the direct relationship between the digital, dynamic map and the rendering of his perception. One teacher was responsible for recording the noise and analyzing the production.

A debriefing was organized at every step. Two questions were addressed: “What sounds do you hear?” and “What is the sound that you hear the best?” Back in the classroom, students drew the route on a map. Then, a few days later, the same questions about the different places that had been visited were asked again. The aim of the activity was to start producing some writing connected with the sounds in order to characterize and present each location. This production took the form of a fictional story about the class’s mascot that discovered different places through sounds. A digital map was made using multimedia elements like text, sound and images.

Next year, this experiment could be extended to other areas of daily living such as shopping centers and domestic spaces. We plan on giving the pupils the opportunity to record and to discuss typical domestic sounds.

Fig. 1: Students at work in the school car park

2.2 Designing soundscapes in lower secondary school

This experiment involved 11 to 13 year-old students new to the school. It related to the geography curriculum: the discovery and the understanding of the nearby space through the concept of “living”. Listening to surrounding noises and sounds is one of the most basic approaches to music education. The goal was to use different recordings to understand this new environment and, therefore, to become aware of the noise, with an emphasis on the effects of groups.

Firstly, it was necessary to develop the students’ noise awareness. They were asked to use a sheet of paper to represent the sounds, their direction and their intensity. This first step was important in raising the awareness of what it means to listen, such as establishing a rhythm for listening: being at a given place, being quiet and listening together for one minute. The form also included gathering some contextual data: such as the location of the sound, the date and the time.

During the second step, we provided students with mobile tools: tablets, smartphones, digital recorders and sound level meters. By themselves, they discovered and recorded sounds at different times of the day. As a result, the measurements varied greatly depending on the recording time, showing the rhythms of school life.

The third step consisted of designing a map to represent this data, *i.e.* mapping the sounds, depending on the position of the student's body and the direction and intensity of the sound. The map was designed with *Scribble Maps*, an online application. Each student selected an icon which showed the orientation of their body, the direction of the noise and its origin through a directional line. Its intensity was represented by the length of this line (a specific assignment, with the mathematics teacher, enabled them to determine the length of the line by relating it to the intensity of the sound). The line colors corresponded to a gradient of colors that conveyed the importance of the noise perceived by the students. The map key indicated the source of the noise (e.g. truck, birds).

Fig. 2: Second experiment: students using the mapping method described

2.3 Addressing geographical problems via soundscapes in upper secondary school level

Listening to the sounds of a city with mobile devices corresponds to the new French geography curriculum for the first class of upper secondary school through the theme "Cities and Sustainable Development". The experiment was carried out with two groups of students. The first group was engaged in fieldwork in Limoges, a city in the center of France. Students surveyed two areas: (1) in the outskirts to show urban sprawl and (2) in the city center to highlight the different areas and the phenomenon of "shrinking cities" which apply to numerous French cities. Students used mobile devices for sound recording. In the morning, the students recorded sounds and measured noise levels along a route, using mobile devices. In the afternoon, they mapped and analyzed the city center. The result was a map that combined the description of the noises and sound recordings. The noise levels were highlighted to show slight differences.

Fig. 3: 3D representation of recorded noise levels in Landouge

A second group carried out additional work. Students analyzed a noise map of Nantes or of the center of Paris. The analysis of the three maps enabled them to compare the three cities (noise levels were comparable despite the different sizes of the cities). Another objective consisted of developing sound mapping skills (including the representation of the data collected by the students and the mathematical methods required to calculate average sound levels).

The students used *Google Earth* in different ways. First, they downloaded their route, which they recorded using *My Tracks*. They changed the color and thickness of the line to better visualize the route. Then, they created a 3D benchmark for each: they used one millimeter of elevation for one decibel. The last step consisted of linking the noise recordings to each benchmark. Therefore, this work led to both qualitative and quantitative mapping in order to give a more overall visualization of the city sound phenomena.

In parallel, a typology of sound was offered to students. Many types of sound and sound effects were mapped, offering a rich and complex panorama. Due to the quality of the recordings and the objectives of the study, a simple typology based on the morphology of sound was introduced. This typology resulted from the student's work. Two main distinctions were made: ordinary vs. extraordinary sounds and natural sounds vs. mechanical sounds. These simple categories demonstrated the prevalence of mechanical and ordinary sounds, especially related to road traffic. From this typology, conclusions were made about the relative peacefulness of peripheral areas. Where natural sounds predominated in general, noise pollution resulted from building projects and urban development.

3 The Impact of Soundscapes on Geographic Education

3.1 Subjective mapping: students as actors and designers

The main objective of the work conducted with the students was to develop a learner centered approach. The students were engaged in collecting, representing, mapping and analyzing geographic data. By taking into account their location during outdoor activities with the objective to hear the noises, the students become aware of their place in this space. "[The same body] is both the first geographical object and particularly the first human actor of geography, who is constantly in contact with the field" (GENTELLE 2009). This is particularly important in primary education; that being said, spatial orientation is also important in secondary school. This involvement of the body in mapping is linked to the process of subjectification and socialization of the body. (DI MEO 2010). The issue of the location of the body and its orientation in space arises again when it comes to mapping the outcomes of these experiments. How to represent the body? Do these choices represent well what was felt? When the students appropriate their environment by mapping, does the resulting map becomes the only trace of this appropriation. As a result, digital mapping, under the guise of scientific objectivity, is very important for personalization (LUSSAULT 2007).

3.2 Mapping as a modeling process

Beyond the assumed subjectivity of maps, students also have to face another problem: the representation of sound. This elusive object is not easily achieved. The main difficulty results from the introduction of time as another dimension. A student listening to the sounds recorded on his mobile device was able to identify the direction and the source of a noise like the voices of people discussing in a particular place or the sound resulting from opening blinds. But the same student might wonder how to represent the noise of a passing airplane. Due to the limitation of 2D representations, it was not possible to represent the altitude of the source or its movement and, thus, its diachronic dimension. Therefore, mapping consisted of choosing what to represent, how to represent it and in facing the limits of the available tools for designing the map. Thus, the map consisted of a subjective and partial model of reality.

The geographical analysis of Landouge, a district of Limoges, was a second example of the difficulty of designing soundscapes. Landouge is a district that enables one to highlight urban sprawl, the distinction between ordinary and extraordinary sounds and the difference between natural and mechanical sounds. The work conducted by students led to active discussion: How does one classify the sounds resulting from home-building? This process encompasses a complex and provisory set of sounds, mainly linked to natural sounds produced by the surrounding environment. This particular situation emphasized the relativity of sound recording and the necessity to make explicit choices for sound and noise mapping. By studying the downtown district of Limoges, the students found a predominance of anthropomorphic noises linked to road improvements, but as soon as this type of noise stopped, natural sounds became preeminent.

By being involved in designing the visualization of soundscapes, the students have to make their own choices and become aware that decisions have to be taken during the modeling process. Thus, maps appear as models, as relative representations of space.

3.3 Identifying the predominance of the visual and cultural substrates

It is always difficult to identify noises, especially in primary school, since writing skills have not yet been acquired. Drawing and speaking results from the expression of a cultural substrate mainly related to sight and not to hearing. The main noises in the car park of the school resulted from passing cars on the road. The sounds produced by children in the school were mainly hidden by mechanical sounds. However, to the question: "what is the noise that comes up most often?" students overwhelmingly answered "the noise of the school". In this case, the visual and cultural representation supplants the reality of listening. This showed the importance of primary representations and the preeminence of sight. Another example was when a student had to draw the origin of the sound of an empty school bus. They drew it with children sitting in the bus. Listening to sound calls on the use of visual memories of everyday life.

When introducing digital mapping, the situation was similar. The sound of the fountain in front of the Regional Council of Limousin in Limoges was spontaneously described by students as particular, fixed and independent from its environment. Thus, they were surprised to discover that the sound of the water of the fountain was widely covered by the noise of car traffic. Mapping the area according to the recorded noises would certainly lead one to not represent the fountain. Indeed, hearing is thus complementary to sight. It demonstrates the importance of the concept of the sound environment – and not only the soundscape – which includes social interactions through the interwoven sounds of various human activities (ROULLIER 1999).

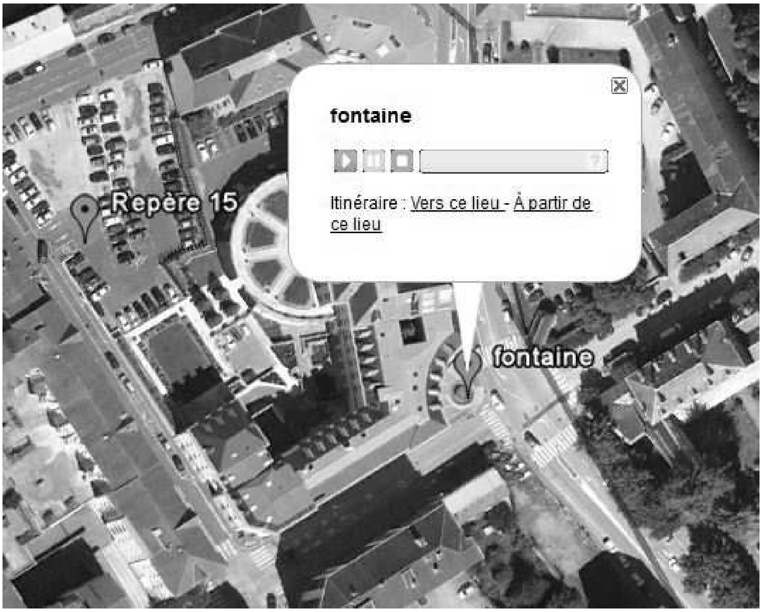

Fig. 4: Mapping records from the fountain next to the Regional Council of Limousin

4 Using Mobile Devices to Record and Locate Noises

Various mobile devices were used during the different experiments. If their use was limited with primary students, they were more heavily used with secondary students. There are two types of mobile devices: devices dedicated to sound recording (digital recorders) and devices dedicated to sound-level measurement (sound level meters). Students also used other mobile devices with more universal use, but with less accurate results: such as smartphones and digital tablets. The main interest of these tools is the possibility to benefit from GPS functionalities, which offer new opportunities for location-based applications. Some applications used for the experiments combined geolocation and data collection: *My Tracks* (geolocation in real time), *NoiseTube* (geolocation and sound level in real time) and *Kinomap Maker* (geolocation and synchronized video recording). These tools offered new perspectives for fieldwork. Indeed, they facilitated data collection by their ability to share and interact with other applications, they supported the analysis and the writing of a final report, they facilitated and accelerated students' work and they avoided long and boring data transfer to a computer. The use of smartphones blurs the border between private and educational tools. However, by comparing the results obtained with a sound level meter and digital recorders, we can state that smartphones offered less accurate data gathering outcomes. The accuracy of smartphones is limited, but the pairing of sound recordings with GPS data offers new perspectives for educational purposes.

5 Conclusion and Implications

Listening to sound and noises to map and study space is still unusual and innovative for geographers and geography education. The different experiments that we carried out offer a starting point for exploring the potential of this educational approach. However, some preliminary conclusions can be drawn from this early work. The preeminence of visual data for spatial analysis is not a fatal outcome and educators could gain from exploring the potential of sound mapping. However, mapping sound and noises within an educational context is difficult despite the development of new digital devices, new Web 2.0 applications and neogeography. Our preliminary work demonstrates that designing soundscapes with students is realistic and offers new opportunities to help students discover their living space. More new projects will follow. We are now involved in the development of our approach by creating an online social network of sound studies. Students, at a national level, will record sounds in their environment, locate them, describe them and comment on them. This network will aim at fostering collaborative learning for geography education.

References

ARTIGUE, M. (1996), Ingénierie didactique. In: BRUN, J. (Ed.), Didactique des mathématiques. Delachaux et Niestlé, Lausanne, 243-274.

ATTALI, J. (2001), Bruits, Essai d'économie politique de la musique. PUF & Fayard, Paris.

AUGOYARD, J. & TORGUE, H. (Eds.) (1998), A l'écoute de l'environnement: répertoires des effets sonores. Parenthèses, Marseille.

BROWN, A. L. (1992), Design experiments: Theoretical and methodological challenges in creating complex interventions in classroom settings. Journal of the Learning Sciences, 2 (2), 141-178.

CHÉTELAT, J. (2009), La figuration cartographique de l'espace sonore [Electronic Version]. Images Revues. Retrieved January 2012 from http://imagesrevues.revues.org/437.

DI MEO, G. (2010), Subjectivité, socialité, spatialité: le corps, cet impensé de la géographie. Annals of Geography, 675, 466-491.

DROIT, R. (2009), The five senses of philosophy [Electronic Version]. The World of Books. Retrieved January 2012 from http://www.rpdroit.com/index.php?option=com_content&view=article&id=88:les-cinq-sens-de-la-philosophie&catid=68:le-monde&Itemid=94.

FRÉMONT, A. (1976), La region, espace vécu. Flammarion, Paris.

GENTELLE, P. (2009), Géographie du corps [Electronic Version]. Cassandre's letters from http://www.cafe-geo.net/article.php3?id_article=1678.

KENT, M., GILBERTSON, D. & HUNT, C. (1997), Fieldwork in Geography Teaching: a critical review of the literature and approaches. Journal of Geography in Higher Education, 21 (3), 313-332.

KRIEGER, J. (1994), Sound and Geographic Visualisations. In: MACEACHREN, A. & TAYLOR, D. (Eds.). Pergamon, New York, 149-166.

LUSSAULT, M. (1996), L'espace pris aux mots In: LÉVY, J. (Ed.), New Geographies, Le Débat, n°92.). Gallimard, Paris, 99-110

LUSSAULT, M. (2007), L'homme spatial. Seuil, Paris.

MARIETAN, P. (2005), L'environnement Sonore – Approche Sensible, Concepts, Modes De Représentation. Champ Social Editions, Nîmes.

MORIN, E. (2000), Seven complex lessons in education for the future. Seuil, Paris.

RODAWAY, P. (1994), Sensuous Geographies: Body, Sense and Place. Routlege, New York/ London.

ROULLIER, F. (1999), Pour une géographie des milieux sonores. Retrieved january 2012, from http://cybergeo.revues.org/5034.

SANCHEZ, E. (2008), Integrating Geomatics into the Curriculum: Inquiry-Based-Learning during a Fieldwork Course. In: JEKEL, T., KOLLER, A. & DONERT, K. (Eds.), Learning with Geoinformation III. Wichmann, Heidelberg, 78-87.

SANCHEZ, E. (2009), Innovative teaching/learning with geotechnologies in secondary education. In: TATNALL, A. & JONES, T. (Eds.), Education and Technology for a better World. Springer, Berlin, 65-74.

SANCHEZ, E., Prieur, M., & Fontanieu, V. (2005), L'enseignement des sciences de la Terre : Que font les élèves sur le terrain ? In: GIORDAN, A., MARTINAND, J.-L. & RAICHVARG, D. (Eds.), Par les mots et par les choses. JIESm Chamonix.

SCHAFFER, R. (1992), A Sound Education: 100 Exercices of Listenning and Soundmaking. Arcana Editions, Indian River, Ont.

SCHAFFER, R. (2010), Le paysage sonore, Le monde comme musique. Wildproject, Paris.

SOJA, E (1996), Thirdspace: Journeys to Los Angeles and Other Real-And-Imagined Places. Blackwell, Oxford.

WANG, F., & HANNAFIN, M. J. (2005), Design-based research and technology-enhanced learning environments. Educational Technology Research and Development. Educational Technology Research and Development, 53 (4), 5-23.