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Traffic Noise Education in Secondary Schools: From Basic Understanding to Active Engagement

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Abstract

Chronic exposure to loud noise has detrimental effects on health, subjective wellbeing and concentration levels of both adults and children. Over two million people in Austria reside in areas where traffic noise surpasses the legal threshold for action. Hundreds of schools are also affected. A similar situation is present throughout large parts of the European Union. Because traffic noise can be heard and measured relatively easily, awareness among the general population is high. Publicly funded data collection has taken place based on EU regulations, and reliable noise maps are available online.

This paper aims to provide teachers with multidisciplinary tools to improve their students' understanding of noise. It suggests project ideas for students to choose depending on their strengths and affinities. The ultimate goal is to enable and motivate students to engage in informed spatial citizenship, notably in taking action to help keep exposure to traffic noise at acceptable levels.

Keywords:

traffic noise, education, secondary school, spatial citizenship

1 Introduction

Noise surrounds many of us throughout our daily lives. Although we can get used to the presence of noise, negative health impacts occur if the noise is loud enough and exposure to it is chronic (Basner et al, 2011). In large geographical areas, traffic or transportation noise caused by roads, trains and aircraft is exactly that: chronic and loud. Unsurprisingly, traffic noise is related to non-auditory health effects such as annoyance, stress, unusual tiredness, sleep disturbance and cardiovascular disease (Öhrström et al, 1988; Miedema and Oudshoorn, 2001; Ouis, 2001; Muzet, 2007; Pirrera et al, 2010; Basner et al, 2011; Sørensen et al, 2012; van Kempen and Babisch, 2012). Because noise is registered by human senses and can be measured easily using apps, awareness of it is high compared to pollutants that are more difficult to detect. Most people are well aware of noise caused by traffic in the city where they live (Pődör & Borsföldi-Nagy, 2018).

On a daily basis, teachers in schools try to keep noise levels down to keep concentration levels up. With good reason, because noise can have detrimental effects on cognitive performance in children (Stansfeld and Matheson, 2003). Chronic traffic noise at home or at school is outside the teachers' control, but it causes stress in children and negatively affects their reading comprehension and test scores (e.g. Cohen et al., 1973; Lukas et al., 1981; Sanz et al., 1993; Evans et al., 1995; Haines et al., 2001a; Haines et al., 2001b; Shield & Dockrell, 2003; Clark et al., 2006; Shield & Dockrell, 2008).

As noise comes from a particular source, such as a running engine, and dissipates though the air, it has an inherent spatial component. Noise levels decrease with increasing distance from the noise source. In addition, the longitudinal waves that constitute sound allow it to be registered despite the presence of an obstacle between the source and the receiver. In practice, this implies that, for example, a car with its engine left running can be seen without being heard if the distance is great enough and the line of sight is free, or heard without being seen when the distance is small enough and the line of sight is blocked. These properties of sound create an opportunity for spatially enabled learning (Vogler et al., 2012) in the form of noise maps, an understanding of noise being fundamental for effective spatial citizenship (Gryl & Jekel, 2012) that aims for an acceptable long-term degree of exposure to traffic noise.

Noise is thus an interesting topic to discuss with students in secondary school. In addition, it can be approached from multidisciplinary perspectives, allows for different learning styles to be accommodated, and readily enables students to discover and improve their own environment. This paper includes some fundamental background knowledge on sound measurement and traffic noise before providing materials and ideas for use in class. The goal is to provide a basis from which further ideas can be developed by teachers and students alike.

2 Quantifying noise levels

When there is noise, sound waves are present. These waves are vibrations in solids, liquids or gases. The loudness of a sound, or the noise level, is determined by the amplitude of the wave (see Figure 1). The pitch of the sound (think of a low bass or a high soprano) is determined by the frequency of the wave. The frequency is given by the number of waves in a given period of time. The shorter every single wave is, or the shorter the wavelength, the higher the frequency and the higher the pitch of the sound. The recognition of a pitch with the human ear requires a sufficiently long sequence of sound waves of a similar length.

Displacement

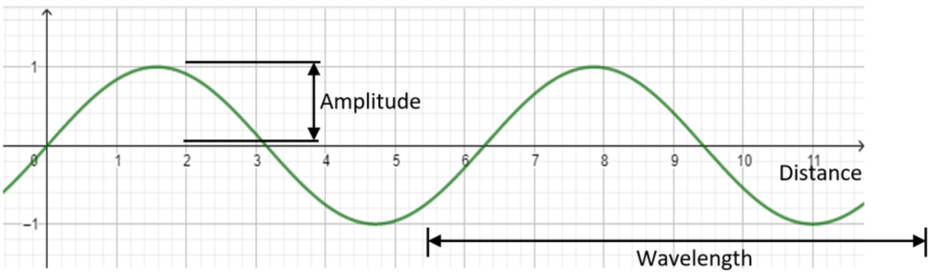

Figure 1: The amplitude and the wavelength of a soundwave

Noise levels are measured in decibels (dB), the scaling of which is based on the power produced by the sound in a non-linear fashion. To be more precise, differences in dB are based on logarithms to base 10 (ISO Standard 80000-3:2006). It is useful to consider an example at this point. Imagine two sounds, one with power x and one with power y. The difference in dB between these two sounds is given by $10 * log_{10}({}^{y}/_{x}) = 10 * lg({}^{y}/_{x})$. If sound y has ten times more power than sound x, then the difference between these sounds is $10 * lg10 = 10$dB. If sound y has a hundred times more power than sound x, the difference between these sounds is $10 * lg100 = 20$dB. The table gives an overview of some important power ratios and dB levels of sound y in comparison to the reference sound x.

Table 1: Power in watts per square metre and dB levels. The reference value at 0dB is one picowatt per square metre.

Power sound x	Power sound y	Power ratio ${}^{y}/_{x}$	dB difference	Sound y example
$1\ ({}^{pW}/_{m^2})$	$1\ ({}^{pW}/_{m^2})$	$1 = 10^0$	0	almost silent
$1\ ({}^{pW}/_{m^2})$	$2\ ({}^{pW}/_{m^2})$	$2 \approx 10^{0.3}$	3	very quiet
$1\ ({}^{pW}/_{m^2})$	$10\ ({}^{pW}/_{m^2})$	$10 = 10^1$	10	light breathing
$1\ ({}^{pW}/_{m^2})$	$100\ ({}^{pW}/_{m^2})$	$100 = 10^2$	20	rustling leaves
$1\ ({}^{pW}/_{m^2})$	$1\ ({}^{nW}/_{m^2})$	$1000 = 10^3$	30	whispering
$1\ ({}^{pW}/_{m^2})$	$1\ ({}^{\mu W}/_{m^2})$	10^6	60	conversational speech
$1\ ({}^{pW}/_{m^2})$	$1\ ({}^{mW}/_{m^2})$	10^9	90	petrol-powered lawn mover
$1\ ({}^{pW}/_{m^2})$	$1\ ({}^{W}/_{m^2})$	10^{12}	120	loud nightclub music

The frequency of a sound is measured in hertz (Hz), or the number of waves per second. The young human ear can register sounds from about 20Hz to about 20,000Hz, the range becoming narrower with age (Cutnell & Johnson, 2014). But to complicate matters, the human ear is more sensitive to some frequencies than others. As a result, a given level of sound (dB) has a different perceived loudness for different frequencies (Hz). Nevertheless, when quantifying the loudness of a sound within a limited range of frequencies, the dB is a good place to start.

3 Traffic as a source of noise

3.1 Types of noise

There are different types of noise source. Sources may be (1) natural or anthropogenic (occupational, social or environmental); (2) stationary or moving; (3) point, line or area sources; (4) making noise (more or less) constantly, intermittently or punctually. A single vehicle in operation represents an anthropogenic environmental moving point source that is making noise constantly. A busy road, railway track or airport, on the other hand, is an anthropogenic environmental stationary line source with more or less constant noise emission.

3.2 Frequency of the noise

Low frequency noise is known to have an especially great annoyance potential. Noise in the 20-200Hz range is closely associated with stress, headaches, unusual tiredness, reduced levels of concentration and irritation. A possible reason is the absence in nature of noises of this frequency range, apart from dangerous events such as volcanic eruptions, storms, thunder and earthquakes (Persson Waye, 2011). Anthropogenic sources such as road traffic, trains and aircraft emit noise in these lower frequency ranges. It is not surprising that road traffic noise, for example, has been associated with greater risk of hypertension, with the effect being strongest for noise with a frequency of 125Hz (Chang et al, 2014).

3.3 Level of the noise

Traffic can cause significant levels of noise. Noise levels above 75 dB are not unusual for noise generated by road, rail and air traffic in the EU including Austria (BMNT, 2018). Railway noise is caused mainly by wheels making track contact, whereas aircraft noise is generated mainly by the engines. In the case of average fossil-fuel passenger cars, engine noise dominates at speeds below 40 km/h, whereas tyre noise dominates at speeds above 60 km/h (Nijland & Dassen, 2002).

3.4 Presence of people

The number of people present in a given area, their vulnerability, the duration of their stay and the frequency of their visits to affected areas all influence the potential effects on health of a given level of noise pollution. Because traffic and industrial activity are so closely related to human activity itself, it is only natural that many people of all ages spend considerable amounts of time being exposed to the noise generated by these sources. Many Austrians are exposed to traffic noise at home and at school, both in denser population centres and in the countryside (see Table 2). On the 1st of January 2018, Austria was estimated to have 8,820,000 inhabitants and an average population density of about 106 people per km2 (Eurostat, 2018). As noise measurements are mandatory in the European Union (Directive 2002/49/EG), noise data is available for every EU country, although the publicly available information may be aggregated differently than in the Austrian example presented here.

Table 2: Number of people based on registered address data and schools affected by noise inside and outside population centres (cities with at least 100,000 inhabitants, or areas with a population density of over 1,000 people per km2) (BMNT, 2018)

A. Noise zones over 24h: Number of people and schools affected						
	Inside population centres			Outside population centres		
	Streets	Railways & tramways	Airports	Streets	Railways & tramways	Airports
55-60 dB	389,400	279,700	10,500	430,200	303,200	20,400
60-65 dB	602,600	207,100	1,500	174,700	132,100	1,800
65-70 dB	633,000	60,100	0	88,100	46,100	0
70-75 dB	357,800	22,800	0	26,200	15,100	0
> 75 dB	130,700	10,300	0	1,200	5,600	0
Total	2,122,600	580,000	12,000	720,400	502,000	22,200
Legal threshold*	60 dB	70 dB	65 dB	60 dB	70 Db	65 dB
Total above threshold	1,724,400	33,000	0	209,200	20,600	0
Schools > 55 dB	153	53	8	224	170	11
Schools > 65 dB	33	7	0	24	30	0
Schools > 75 dB	1	1	0	0	3	0
B. Noise zones at night (10 pm to 6 am): Number of people affected						
	Inside population centres			Outside of population centres		
	Streets	Railways & tramways	Airports	Streets	Railways	Airports
45-50 dB	370,200	no data	6,000	514,200	no data	12,200
50-55 dB	491,400	268,900	0	219,300	248,600	900
55-60 dB	754,800	109,600	0	102,400	99,700	200
60-65 dB	360,500	41,400	0	39,700	34,500	0
65-70 dB	219,600	17,000	0	4,400	10,400	0
> 70 dB	23,000	4,000	0	0	3,800	0
Total	2,219,600	219,900	6,000	880,100	397,000	13,300
Legal threshold*	50 dB	60 dB	55 dB	50 dB	60 dB	55 dB
Total above threshold	1.849.300	53.400	0	365.800	48.700	200

* If average noise levels exceed the legal threshold, governments are mandated by the EU to devise plans to mitigate noise at the affected locations.

3.5 Noise maps

Noise maps generated by the Austrian Ministry for Sustainability and Tourism show the average noise levels generated by traffic on main roads, main railway lines and commercial airports (as well as by larger industrial facilities). Measurements were undertaken by the provincial authorities and conducted at 4 metres above ground level. Digital maps are available for noise originating from provincial roads, highways, railway tracks and airports. Complete street coverage is available for the larger provincial capitals of Graz, Innsbruck, Linz, Salzburg and Vienna.

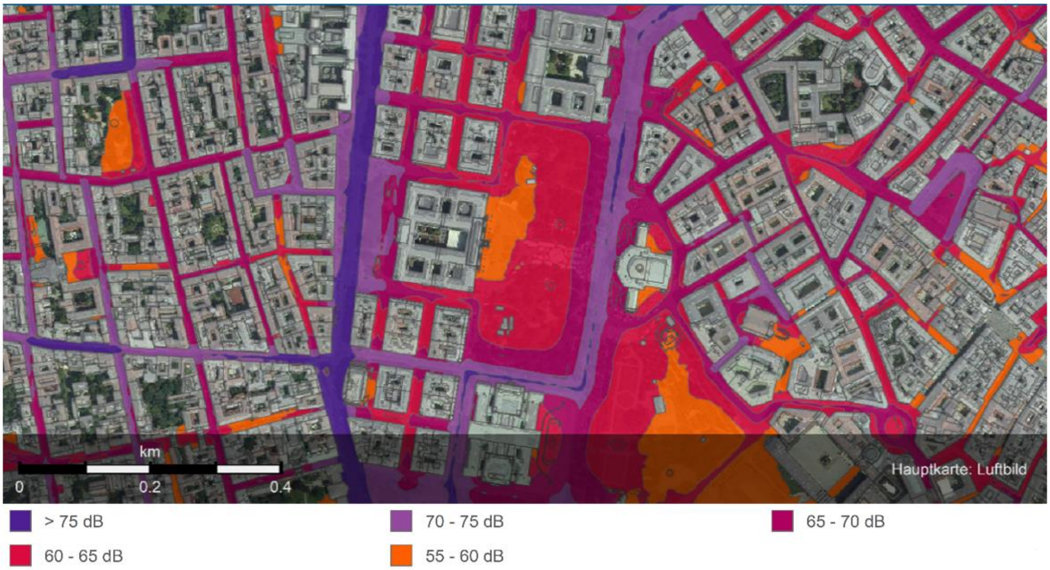

Figure 2: Exemplary map for average noise levels over 24h caused by road traffic, measured at 4 metres above ground, around the city hall in Vienna (Rathausplatz). Source: www.laerminfo.at (retrieved on 19.12.2018).

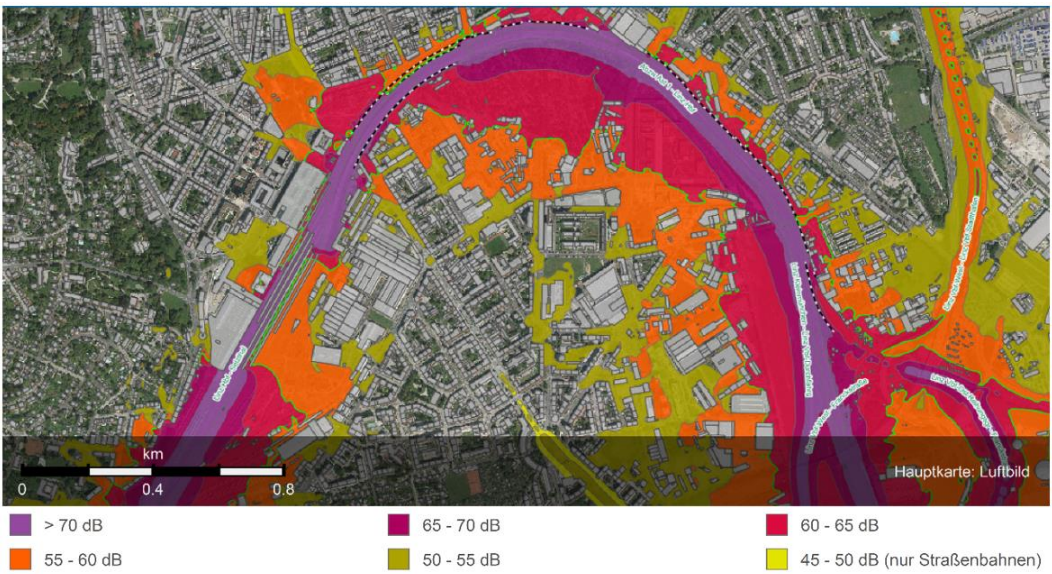

Figure 3: Exemplary map of average noise levels during the night caused by railway traffic, measured at 4 metres above ground level in an area including the central station in Linz (located above the linear scale of the map). Source: www.laerminfo.at (retrieved on 19.12.2018).

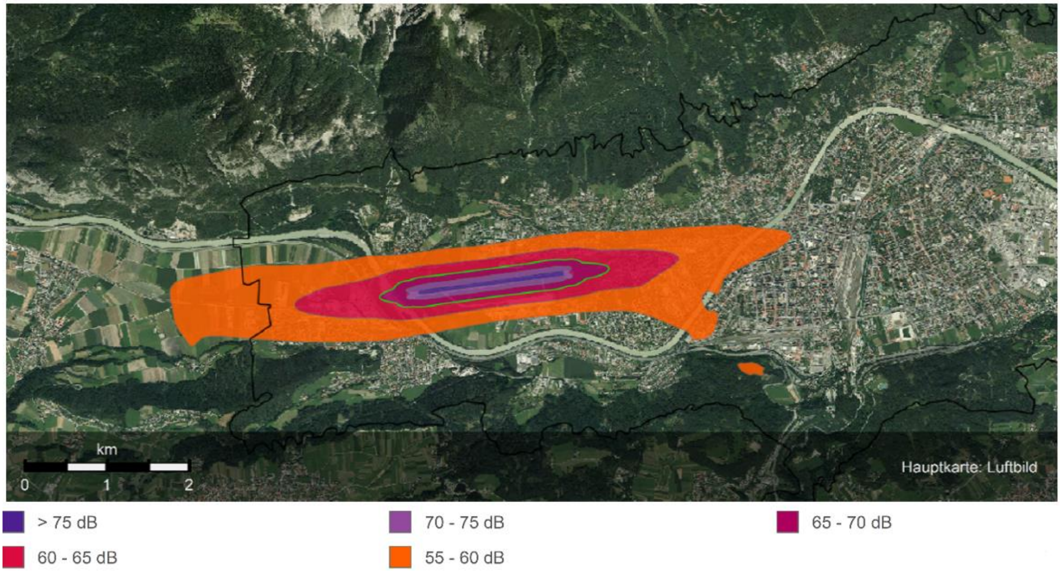

Figure 4: An exemplary map of noise levels over 24h caused by aircraft, measured at 4 metres above ground around the airport in Innsbruck. Source: www.laerminfo.at (retrieved on 19.12.2018).

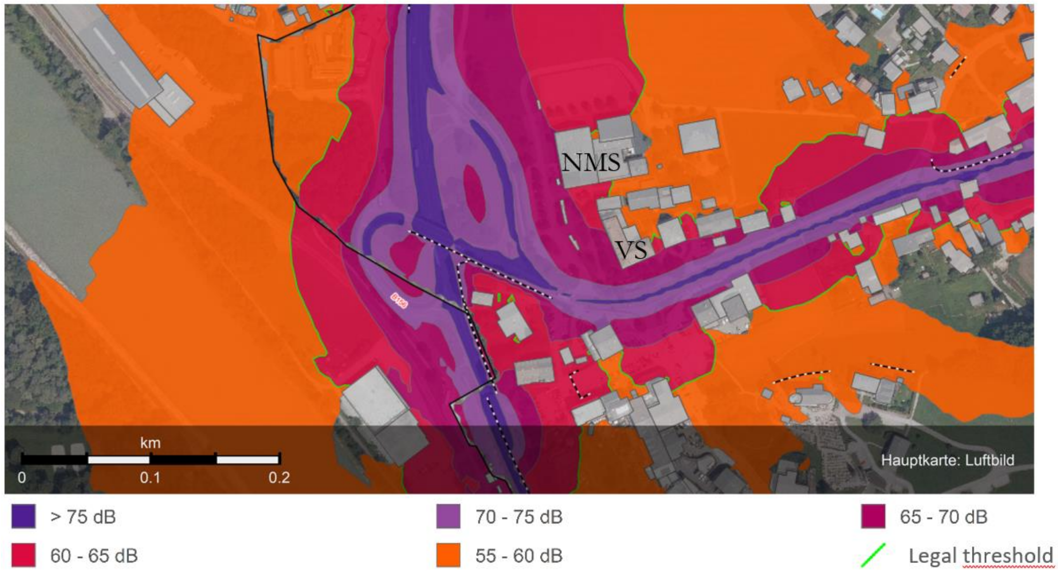

Figure 5: Exemplary map for average road noise levels over 24h, measured at 4 metres above ground around the primary school (VS=Volksschule) and secondary school (NMS=Neue Mittelschule) in Bergheim bei Salzburg. Source: www.laerminfo.at (retrieved on 03.01.2019).

4 Teaching materials

The teaching materials are meant to provide a minimum understanding of what sound is, how to measure sound using a smartphone, a heightened awareness of the sounds surrounding us and of how they can affect us physically and emotionally, as well as an introduction to traffic noise. The contents of the materials relate to multiple subjects: physics, musical education, biology and geography. The Table below summarises these subjects and suggests noise-related activities in other subject areas.

Table 3: Examples of sound and noise as multidisciplinary subjects

A. Included in teaching material	
Physics	The physical properties of sounds and how to quantify them
Music	Experiencing, describing, making and evaluating sounds and pitch
Biology	Using our ears to register sounds and the effects of noise on wellbeing
Geography	The geographical distribution of traffic noise (noise maps)
B. Further suggestions	
Languages	Discuss newspaper articles on traffic noise and write an opinion piece of your own
Mathematics	The functional forms of decibel and hertz, including graphical representations
History	Noise surrounding people in the past and today. What were the sources then?
Sports	Can sounds help me run faster? If so, what sounds are most effective?
Economics	Selling noise and quietness: car engine noise generated by the speaker system
Political Science	Decision making in relation to construction of noise barriers, flight times and routes, etc.
Art	Drawing sounds: depicting different types of sounds

Table 4: Multiple intelligences in the mini-projects

Intelligence description (Gardner, 1999)	Description in mini-projects
1. Visual-spatial	Picture smart
2. Logical-mathematical	Number smart
3. Verbal-linguistic	Word smart
4. Naturalistic	Nature smart
5. Musical-rhythmic and harmonic	Music smart
6. Bodily-kinaesthetic	Body smart
7. Intrapersonal	Me smart
8. Interpersonal	People smart
9. Existential	Soul smart

In addition to the teaching materials outlined in Table 3, nine mini-projects related to (traffic) noise are offered for students to choose from. Each exercise offers a relatively high degree of freedom and aims to fit one of the nine intelligences proposed by Gardner (Gardner, 1999). In general, students know where their strengths lie and will choose their tasks accordingly. If time permits, time can be spent on tests and self-assessments to determine which of the multiple intelligences are most developed in different students. For ease of understanding by students, the different intelligences have been given new names in the exercise sheet explaining the mini-projects, as described in Table 4.

The subject of traffic noise and the proposed materials also address a range of overarching goals, as codified in a number of legally binding educational policy documents in Austria, such as traffic and mobility education, health education, digital education and education for sustainable development. As was the case for the different subject areas, the materials are meant simply to provide a basis on which to build. For example, students' noise measurements can be mapped digitally (e.g. ArcGIS Online) and statistically and spatially analysed. Furthermore, students' personal interests and perceptions can be included explicitly.

The exercises presented in the teaching materials were trialled in class. As a result, the following advice can be offered. (1) Agree on a clear signal for students to be completely (!) quiet. Practise this signal from the front of the classroom at the start of every class. If the class has difficulties staying quiet, it may be helpful to start with the listening exercise with closed windows and closed doors. Asking students to really concentrate on listening and discovering sounds not heard before increases the likelihood of them remaining silent. (2) Take the time to download and install the app of your choice in class on the devices to be used and try the app (for example by shouting as loud as possible). Asking students to install the app at home only saves time if all students do so, which is highly unlikely in practice. (3) When using the tone generator, use a single speaker to generate the tone to avoid constructive and destructive interference. If possible, get students to stand in a semi-circle around this speaker so that they are all the same distance from it, with a data projector displaying the screen of the tone generator behind it. (4) Show a video, in slow motion, of a guitar string that has been plucked, and pluck the guitar string live in class. (5) Showing the propagation of transverse waves (e.g. light) next to that of longitudinal waves (e.g. sound) can increase understanding. (6) The noise maps presented here are Austrian. Similar data and maps should be available for all EU countries and can easily be used instead if desired. (7) The different types of intelligence and the mini-projects may require explanation.

Although no formal survey was carried out, a few words on the perceived learning effects may be of interest. Almost all students gained a very good understanding of the basic physical properties of sounds and how humans register just a limited range of sounds with their ears. Students gained insights into how to carry out experiments and the different ways in which observations can be made, recorded, structured and interpreted. Potential differences between making observations with human senses and using electrical measurement equipment such as a smartphone with an app became apparent. Moreover, using apps proved to be a very effective means to get to grips with the non-linearity of the dB scale. Some students continued measuring ambient sound levels on a daily basis for a number of weeks. During the mini-projects especially, self-motivated interdisciplinary work of admirable quality was achieved. Most importantly, however, students' awareness of the broad range of sounds, including traffic noise, that constitute an ever-present part of their daily lives has increased substantially.

5 Conclusion

Many us of are surrounded by noise throughout large parts of the day. Chronic exposure to noise above a certain volume negatively affects our health, ability to concentrate and feeling of wellbeing. A very important source of chronic ambient noise is traffic. This paper aims to provide teachers with background information and materials for multidisciplinary classes on traffic noise during the first years of secondary education. This multidisciplinarity allows students of different abilities and with varying interests to approach the subject and to embed new insights into existing thought processes. Methods and knowledge that students have acquired in different subject areas can be practised by applying these to traffic noise. Preliminary ideas for expansion beyond physics, geography, music and biology are presented. By catering for the different types of intelligence, interests and skills that students possess, the proposed mini-projects give students the opportunity to further develop themselves in an area of their choice.

The ultimate goal is to provide students with sufficient interest in and understanding of traffic noise, its consequences and potential solutions. The use of noise maps supports active engagement in public debate and spatial citizenship to achieve acceptable long-term levels of traffic noise exposure via targeted and effective action. The skills developed may thereafter be used to address other types of ambient pollutants that are more difficult to register with human senses, such as carbon dioxide, nitrogen oxides, ultrafine particles, radiation and so on.

Acknowledgement

The Federal Ministry of the Republic of Austria for Sustainability and Tourism generously granted permission to use the noise maps available on laerminfo.at for this paper.

Measuring sounds – ear and smartphone

Download and install an app on your smartphone to measure the volume of a sound (e.g. Sound Meter).

Open a tone generator on the internet.
(e.g. http://www.szynalski.com/tone-generator/)

You will have to be very quiet now.

Use the tone generator to play a tone at full volume. Adjust the speakers so that you get 50 dB on your teacher's smartphone. Calibrate your apps with that of your teacher.

Use the tone generator to play a tone at full volume. Adjust the speakers to 50 dB on your app.

Decrease the volume in the tone generator by half.

My app now measures a sound level of .... dB.

Decrease the volume in the tone generator by half.

My app now measures a sound level of .... dB.

Decrease the volume in the tone generator by half.

My app now measures a sound level of .... dB.

Every time I decrease the volume by half, the sound level is decreased by about ....dB.

Use the tone generator to play a tone with 110 Hz. Change the tone to 220 Hz. Complete the sentences:

The tone with ....Hz makes the higher sound.

The tone with ....Hz makes the lower sound.

What sounds can you hear? Beat the teacher!

Use the tone generator to play a tone with 30dB and 220 Hz. Keep decreasing the volume.

The quietest sound I can hear has ....dB.

My teacher can hear down to ....dB.

Start at 40 Hz. Keep decreasing to 10 Hz.

The lowest sound I can hear has ....Hz.

Start at 18,000 Hz. Slowly increase to 20,000 Hz.

The highest sound I can hear has ....Hz.

My teacher hears from ....Hz to ....Hz.

Everyone has different hearing. Some people can hear sounds that others can't. Your hearing gets worse when you are exposed to loud noises and as you get older.

Animals have different hearing from us. For example, dog whistles make a sound of about 54,000 Hz. Humans cannot hear such sounds, but dogs can!

Soundwaves are caused by vibration

Download and install an app (e.g. Spectroid) on your smartphone to measure the frequency of a sound.

<u>You will have to be very quiet now.</u>

Switch on your app. Play the second lowest string on a guitar. Your hear the concert pitch (a' 440Hz).

The note being played has ....Hz.

The musical note .... is being played.

Observe the string closely. How does it move? Sketch the moving string below.

● ●

● = fixed point, called a node

Measure the length of the same string on the guitar. Exactly in the middle create a new node by placing your finger on the string.

The note being played has ....Hz.

The musical note .... is being played.

Sketch the moving string below.

● ● ●

Sound is caused by a vibrating object, for example a guitar string that has been plucked. Such an object is a sound source.

You are also a sound source. Let's give it a go.

Switch on your app. Start a new measurement. You may have to reset the app to delete previous data. One after another, whistle as loud as you can.

I get up to ....dB and ....Hz.

Start a new measurement in your app. Whistle together as loud as you can.

Together, we get up to ....dB.

The noise has a clear level of Hz : □ yes □ no

The teacher's smartphone is going to play a song in the corridor. Measure the volume with your smart-phone. The volume in the classroom is similar when:

the door is completely open:	**□ yes**	**□ no**
the door is opened halfway:	**□ yes**	**□ no**
the door is left ajar:	**□ yes**	**□ no**
the door is completely shut:	**□ yes**	**□ no**

Switch on an alarm. Put it in a vacuum chamber. Pump out the air. Can you still hear the alarm?

Hearing sounds – Listen carefully

All windows and doors should be closed. Be quiet and listen carefully for one minute. Afterwards, depict the sources of the sounds on the map.

In front of me

To the left

To the right

Behind me

quiet	1	2	3	4	5	loud
pleasant	1	2	3	4	5	annoying

For this exercise, all windows should be opened. Again be quiet and listen carefully for one minute.

In front of me

To the left

To the right

Behind me

quiet	1	2	3	4	5	loud
pleasant	1	2	3	4	5	annoying

In pairs, measure each other's heartbeat for exactly one minute. Sit down facing each other and be as calm as possible. Rest one arm on your knee and get your partner to feel your pulse.

My heartbeat is beats/min.

You may now have heard traffic noise. If so, you are not alone. Many schools and homes in Austria suffer from traffic noise.

Listen to road traffic noise on the internet. Use your Apps to adjust the volume to an average of 60 dB. Be quiet and listen carefully for one minute.

quiet	1	2	3	4	5	loud
pleasant	1	2	3	4	5	annoying

Listen to the road traffic noise at 60 dB. Measure each other's heartbeat again for exactly one minute.

My heartbeat is beats/min.

The legal limit beyond which action for road traffic noise should be taken is an average 60 dB over 24h. I think that is...

Mapping traffic noise

Sound can be mapped using contour lines with colour-coding for given levels of dB.
Can you find out which type of traffic noise is shown on the three maps A, B and C?

Road noise in central Vienna **Railway noise in Wels** **Aircraft noise in Innsbruck**

- > 75 dB
- 60 - 65 dB
- 70 - 75 dB
- 55 - 60 dB
- 65 - 70 dB

Maps were downloaded from www.laerminfo.at (19.12.2018). The maps can be viewed online on computer and smartphone.

Traffic noise: projects to choose from

Complete at least ____ of the following projects by _______: ___________________

Picture smart	**Number smart**	**Word smart**
Draw a map of one floor of your home. Include the rooms and large pieces of furniture. Draw open or closed doors and windows. You may also include the garden or balcony. Listen to the sounds carefully. Where do they come from? Add the sources to your map using your imagination. Hand in: an A3 sheet of paper with your drawing	Print out the official (noise) map for your school and about 200 metres in every direction around it. Measure noise levels and frequencies at different outside locations using a smartphone. Write your dB measurements on the map. Compare your measurements with the official noise map. Hand in: an A3 sheet of paper with your findings	Write a letter to the mayor about the traffic noise at your school and in your town. Suggest how to improve the situation and try to convince the city council to take action. Post this letter. Tip: include an official noise map to help make your point. Hand in: a copy of the letter, envelope and possible reply
Nature smart	**Music smart**	**Body smart**
Find a ‘quiet’ place in nature completely without traffic noise. Record the sounds for a minute, without talking, using a smartphone. To the same recording, next add your verbal descriptions of all the sounds that can be heard. Hand in: sound recording with your comments	Make a song about traffic noise. You may use traffic noise recordings, your voice, musical instruments or any other sounds you make yourself. Video yourself performing (?) the music. Hand in: video clip of the song	Build a box with maximum sound-proofing. It should be big enough to hold your mobile phone. Test the box by playing the same loud music or ringtone outside and inside the box. Compare the volume of the sound. If you wish, you can use a second mobile phone to measure dB levels. Hand in: your box, a short explanation and test recording.
Me smart	**People smart**	**Soul smart**
Choose eight sounds and listen carefully to them with your eyes closed. Make a list of these sounds. Describe them and explain what you feel when listening to each of them. Some of the sounds should relate to traffic. Think of cars, bikes, boats, planes, etc. Hand in: list with sounds, feelings and explanations	Prepare a list of at least five questions about traffic noise and how this is perceived. Interview five people using your questions. Then form your own opinion. Tip: you may record the interviews and then write down the answers. Hand in: questions with answers and own opinion	Create a quiet zone in class or in school. Come up with an idea to reduce noise and create space for daydreaming and peaceful thinking. Try to make the idea easy to carry out. Write a short explanation of the idea and explain how it is supposed to work. If helpful, you can also draw a sketch of the idea. Hand in: description of the idea. Can be tried in class!

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