

# 1 Increasing Earthquake Awareness: Seismo-at-school Switzerland

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14 **Abstract.** The *Increasing Earthquake Awareness in Switzerland* project set out to connect students, teachers, and the wider  
15 public with earthquake science by reviving and extending the nationwide *seismo@school* initiative. Supported by the Swiss  
16 National Science Foundation (SNSF) AGORA programme, the project developed a suite of multilingual teaching resources,  
17 deployed near real-time seismic sensors in schools, and created hands-on activities such as the *Lambda Slinky Seismometer* kit  
18 to engage 12- to 18-year-olds. Although Switzerland is exposed to only moderate seismic hazard, earthquakes remain the  
19 natural hazard with the highest damage potential. Because most residents have never experienced a damaging earthquake,  
20 educational programmes play a crucial role in raising awareness and strengthening preparedness. Moreover, *seismo@school*  
21 initiatives can inspire younger generations to pursue geosciences by helping them appreciate the relevance of the field. This  
22 article presents the rationale, implementation, and impact of the project, and may serve as a guide for other countries seeking  
23 to develop similar initiatives. It examines how experiential, data-driven educational approaches can improve earthquake  
24 awareness and preparedness in moderate-hazard regions, how school-based seismometers benefit both teaching and scientific  
25 monitoring while considering the practical challenges of installation and operation, and what institutional and policy conditions  
26 are required to sustain such efforts over the long term.

## 27 1 Introduction

28 Although Switzerland is not among the most seismically active regions in the world, earthquakes remain an underestimated  
29 risk. Historical events such as the Basel earthquake of 1356 (Mw ~6.6) and the more recent 1946 Sierre earthquake (Mw 5.8)

30 - still recalled by some of the local population - highlight the hazard in a country where damaging earthquakes occur roughly  
31 every 100 to 150 years (Wiemer et al., 2016; Fäh et al., 2011). National hazard models show overall moderate seismicity, with  
32 the highest hazard in Valais, followed by Basel, Grisons, Central Switzerland, the St. Gallen Rhine Valley, and the rest of  
33 Switzerland. Earthquakes represent the natural hazard with the greatest potential to cause casualties and economic losses in  
34 Switzerland (FOCP, 2026; Wiemer et al., 2023). However, because few inhabitants have ever felt strong earthquake shaking,  
35 either domestically or abroad, public awareness and preparedness remain low (Dallo et al., 2022a).

36 Although seismic hazard in Switzerland is moderate, strong earthquakes will occur again, and preparedness will be a major  
37 advantage. Educational initiatives play a crucial role in building community resilience by embedding knowledge of earthquake  
38 processes, hazard, and risk into school curricula and public discourse. International experience shows that citizen seismology  
39 and educational seismology (*seismo@school*) programmes are particularly effective for engaging with the public and spreading  
40 knowledge in earthquake prone countries (e.g., Chen et al., 2020). They also help motivate younger generations to study  
41 geosciences, even in regions where earthquakes are less common (e.g., Denton et al., 2018). Key examples include the SISMOS  
42 à l'École network in France, which has successfully run for over 25 years and is now managed by EDUMED-Obs, the  
43 Mediterranean Educational Observatory at the Université Côte d'Azur (Berenguer et al., 2020; Courboulex et al., 2012); the  
44 UK School Seismology Project (Butcher et al., 2011; Denton et al., 2008), run by the British Geological Survey; the European  
45 EDUSEIS initiative (Zollo and Bobbio, 2000; Cantore et al., 2003); and the long-running U.S. IRIS Seismographs in Schools  
46 programme (Braile et al., 2003; Bravo et al., 2020). The success of these programmes has been driven often by installation of  
47 low-cost seismometers at schools, as demonstrated, for example, in Nepal (Subedi et al., 2020a, 2020b), Australia (AuSIS;  
48 Mousavi et al., 2022), Ukraine (Amashukeli et al., 2024), New Zealand (CRISiSLab Challenge; Tan et al., 2022), Ireland  
49 (QuakeShake; <https://quakeshake.ie/home/>, last accessed April 2026), or at Yale University (Löberich and Long, 2024).

50 Building on this international experience, a temporary project in Switzerland (Sornette and Haslinger, 2009), as well as on the  
51 implementation of an educational seismology project in Nepal (Subedi et al., 2020a) by the University of Lausanne (UNIL),  
52 the first phase of *seismo@school* in Switzerland was launched in 2021 in the French-speaking cantons of Vaud and Valais.  
53 Over two years, a network of schools and school seismometers was established, led by UNIL, the University of Applied  
54 Sciences and Arts in the Valais region (Haute École Spécialisée de Suisse Occidentale Valais-Wallis, HES-SO Valais-Wallis),  
55 and the Earthquake Prevention Learning Centre (Centre de Prévention des Séismes, CPPS) in Sion.

56 To make this initiative a national programme, these institutions joined forces with the Swiss Seismological Service (SED) at  
57 ETH Zurich (ETHZ) and other partners, which played a central role in expanding the network and offering further scientific  
58 and operational expertise. Led by the SED, they launched the *Increasing Earthquake Awareness in Switzerland* project in May  
59 2023, targeting 12–18-year-olds (Dallo et al., 2023; Böse et al., 2024a; Hetényi et al., 2025). This two-year project aimed to  
60 revitalise and expand *seismo@school Switzerland* by providing schools with updated educational resources reflecting current  
61 knowledge in seismology and related fields, Raspberry Shake classroom seismometers for earthquake recording, and a simple

62 *Lambda Slinky* seismometer kit for hands-on assembly to introduce the principles of seismic monitoring. Additional objectives  
63 included strengthening STEM education and addressing the declining number of students pursuing Earth Sciences and related  
64 fields as future career paths.

65 In this paper, we investigate how experiential, data-driven educational approaches can enhance earthquake awareness and  
66 preparedness in moderate-hazard regions; how school-based seismometers support both teaching and scientific monitoring  
67 while introducing practical challenges regarding installation and operation; and what institutional and policy conditions are  
68 necessary to sustain such efforts over the long term. We first present the project components and their implementation,  
69 including the development and dissemination of multilingual teaching materials on earthquake-related topics. We then examine  
70 the benefits and limitations of deploying low-cost seismometers in schools, followed by the introduction of a student-  
71 assembled seismometer kit designed to familiarise students with basic monitoring principles and foster engagement. In the  
72 next section, we outline the methods and results of a survey conducted with teachers at participating schools at the end of the  
73 project, which serves to evaluate the educational impact of the presented activities. Finally, we discuss the challenges  
74 associated with implementation and long-term sustainability of *seismo-at-school* and propose possible pathways for future  
75 developments of the initiative.

## 76 **2 Project Components and Implementation**

### 77 **2.1 Teaching Resources**

78 A first key outcome and central achievement of our project was the development of a comprehensive set of teaching resources  
79 on earthquake-related topics. While the official Swiss school curriculum defines clear teaching objectives, existing educational  
80 materials - particularly on socially relevant seismic themes - remain limited, underscoring the need for updated, multilingual,  
81 and visually engaging resources aligned with the curriculum. The content of the resources was identified and developed in  
82 close collaboration with scientists and teachers, beginning with an online survey to ensure relevance to classroom needs. The  
83 materials were structured into five thematic modules (*General Earthquake Knowledge, Earthquake Monitoring and Raspberry*  
84 *Shake, Seismic Hazard and Risk in Switzerland, Induced Seismicity, and Misinformation and Media Literacy*), each comprising  
85 a general introduction and a Swiss-specific component. Each module combines explanatory texts with graphics and a variety  
86 of interactive elements, including quizzes, experiments, and hands-on activities, targeting 12- to 18-year-olds, and expected to  
87 be completed within 1 to 2 hours. The educational materials encourage active participation through practical exercises, critical  
88 thinking tasks, and real-world examples, helping students connect scientific principles with everyday experience.

89 The resources can be used as stand-alone topics or complete modules, depending on curricular requirements and lesson  
90 planning. This structure allows teachers to integrate the educational materials flexibly into science and geography lessons. To  
91 maximise reach across Switzerland - a country with four official languages - and to facilitate international outreach, the

92 resources were translated into German, French, Italian, and English, and made available through a dedicated SED  
93 *seismo@school* webpage (<http://seismo.ethz.ch/en/news-and-services/for-schools/teaching-resources>, last accessed April  
94 2026). The educational materials were promoted through (geography) teacher networks (e.g., online Teams groups),  
95 workshops, and direct engagement with schools. The following sections provide a summary of each of the five modules.

### 96 **2.1.1 General Earthquake Knowledge**

97 The *General Earthquake Knowledge* module introduces the fundamental science of earthquakes, beginning with the role of  
98 plate tectonics and fault movement in generating seismic activity. Students learn how stress accumulates along tectonic  
99 boundaries and is released as seismic waves during earthquakes. The material explores where earthquakes occur – mostly  
100 along active margins such as the Pacific *Ring of Fire*, but also in intraplate regions (such as Switzerland), volcanic zones, or  
101 due to other natural phenomena and human activity triggering earthquakes. Different exercises and visual aids help illustrate  
102 these geological processes and set the foundation for understanding earthquake origins.

103 A second focus of the module is the characterization and measurement of earthquakes. The differences between P-waves, S-  
104 waves, and surface waves are discussed, along with concepts such as hypocentre, epicentre, magnitude, and intensity. Case  
105 studies and analogies clarify how magnitude measures total energy release, while intensity captures local effects. Tools such  
106 as ShakeMaps and early warning systems are introduced to show how scientists monitor and communicate earthquake data  
107 and information to the public. These components combine theoretical knowledge with real-world applications, encouraging  
108 students to interpret seismic information critically.

109 The final section addresses seismic risks, consequences, and preparedness. Students learn about direct impacts of earthquakes  
110 like structural damage and casualties, as well as secondary hazards including tsunamis, landslides, and liquefaction. Emphasis  
111 is placed on practical safety strategies such as earthquake resistant construction, earthquake insurance as well as  
112 recommendations for actions to be taken *before*, *during*, and *after* a strong earthquake. Through exercises and scenario-based  
113 tasks, students apply this knowledge to both Swiss and international contexts, raising awareness of earthquakes and their effects  
114 while strengthening society’s resilience.

### 115 **2.1.2 Earthquake Monitoring and Raspberry Shake**

116 The *Earthquake Monitoring and Raspberry Shake* module traces the history of earthquake detection from early instruments,  
117 such as Zhang Heng’s seismoscope, to today’s highly sensitive electromechanical devices. Students are introduced to the Swiss  
118 National Seismic Network, which includes over 200 permanent monitoring stations across the country operated by the SED.  
119 A simple method is introduced to demonstrate how earthquakes can be located via triangulation, which uses differences in P-  
120 and S-wave arrival times at various stations. By analysing seismograms and applying simple formulas, students gain hands-on  
121 insight into this method. They also learn why triangulation is not used in professional seismic monitoring.

122 The second part of the module focuses on Raspberry Shake seismometers, which are affordable and user-friendly devices to  
123 record earthquakes mostly for non-professional use. In the scope of our *seismo@school* initiative, we deployed Raspberry  
124 Shake seismometers in 46 Swiss schools (see **Figure 1, Chapter 2.2**). Students learn how geophones in the devices convert  
125 ground vibrations into digital signals, which can then be visualized, for example, through the Raspberry Shake webpage  
126 (<https://stationview.raspberrypi.org/>, last accessed April 2026), allowing real-time exploration of seismograms,  
127 spectrograms, and daily helicorder plots. The exercises highlight how everyday seismic *noise*, such as traffic, concerts or  
128 variable-frequency sources (helicopter, washing machine), also appears in recordings, helping students distinguish natural  
129 from human-induced vibrations.

130 To extend the learning, students engage with programming and data analysis using a Jupyter Notebook. This environment  
131 allows them to process and interpret recordings from the Swiss school network, familiarizing them with basics of scientific  
132 programming. By connecting classroom learning to live data and real monitoring tools, the module combines theoretical  
133 seismology with practical, technology-driven investigation. It provides an authentic experience of how earthquakes are  
134 monitored, recorded, and data interpreted, while also encouraging older students to conduct their own scientific projects.

### 135 **2.1.3 Earthquake Hazard and Risk in Switzerland**

136 The *Earthquake Hazard and Risk in Switzerland* module introduces the key concepts of earthquake hazard and risk,  
137 emphasizing the distinction between natural probability and human vulnerability. *Hazard* refers to the likelihood or probability  
138 of earthquakes occurring in a specific region, whereas *risk* describes the potential consequences or impacts of these events on  
139 people, infrastructure, and society. Using everyday analogies, students see how external events are unavoidable, yet how  
140 preparedness and resilience influence outcomes. The module offers different exercises using Switzerland's seismic hazard and  
141 risk models to help students better understand the two terms.

142 Following the general introduction, the module examines the distribution of earthquake risk across Switzerland, showing how  
143 urban areas like Basel, Geneva, Zurich, and Bern face higher risk due to dense populations and concentrated assets (Wiemer  
144 et al., 2023). Historical examples, such as the 1356 Basel earthquake, illustrate how the consequences of seismic events vary  
145 over time, reflecting differences in urban development, construction standards, and possibly societal preparedness between  
146 past and present contexts. Earthquake scenarios for various Swiss cities illustrate the potential damage in terms of building  
147 damage costs, fatalities, the number of people seeking shelter, and other key indicators of societal disruption (Marti et al.,  
148 2023). By comparing different scenarios and conducting an exercise using the SED *Earthquake Risk Tool*  
149 ([www.seismo.ethz.ch/earthquake-country-switzerland/risk/earthquake-risk-tool/](http://www.seismo.ethz.ch/earthquake-country-switzerland/risk/earthquake-risk-tool/), last accessed April 2026), students analyse  
150 and discuss the various factors influencing risk in detail. Finally, the Swiss case is set within global and European contexts  
151 (Danciu et al., 2021; Crowley et al., 2021). Comparisons with higher-hazard regions in southern Europe highlight  
152 Switzerland's moderate hazard but significant risk due to infrastructure density. Interactive mapping tools from European

153 ([www.efehr.org](http://www.efehr.org), last accessed April 2026) and global hazard and risk models (<https://www.globalquakemodel.org/>, last  
154 accessed April 2026) invite students to explore worldwide variations.

#### 155 **2.1.4 Induced Seismicity**

156 The *Induced Seismicity* module examines how human activities – such as mining, dam construction, fracking, wastewater  
157 injection, CO<sub>2</sub> storage, and deep geothermal energy projects – can trigger earthquakes (e.g., Moein et al., 2023). Although  
158 most induced events are small and pose minimal risk, some have caused significant damage, raising important safety and risk  
159 management concerns (Grigoli et al., 2017). Over recent decades, induced seismicity has become an increasingly prominent  
160 multidisciplinary field of research, integrating perspectives from engineering, geology, and social sciences (e.g., Paluszny et  
161 al., 2024). At the same time, these phenomena continue to provoke public and political debate. The module specifically  
162 investigates induced seismicity in the context of deep geothermal energy, exploring it through multiple disciplinary and societal  
163 lenses.

164 The module situates geothermal energy within Switzerland’s national climate strategy, emphasizing its potential contribution  
165 to achieving net-zero emissions by 2050. Students examine the principles and applications of deep geothermal energy,  
166 exploring both the opportunities and challenges associated with petrothermal and hydrothermal systems. These concepts are  
167 illustrated through Swiss case studies, including the Basel (2006) and St. Gallen (2013) projects (Mignan et al., 2015; Diehl et  
168 al., 2017), where induced earthquakes ultimately led to the cancellation of geothermal operations, underscoring the complex  
169 balance between renewable energy development and seismic risk management.

170 Classroom exercises include role-play debates, allowing students to adopt the perspectives of stakeholders such as residents,  
171 authorities, environmental organisations, and energy companies. These activities foster discussion on balancing sustainable  
172 energy development, public acceptance, and safety. By linking scientific understanding with social decision-making, the  
173 module underscores the interdisciplinary nature of earthquake risks and energy policy.

#### 174 **2.1.5 Misinformation and Media Literacy**

175 The *Misinformation and Media Literacy* module examines the dissemination of earthquake-related misinformation and fosters  
176 students’ critical media literacy. It clarifies the distinctions between misinformation, disinformation, fake news, and conspiracy  
177 theories, enabling students to critically assess information sources and understand how inaccurate narratives can shape public  
178 perception and responses (Dallo et al., 2022b). Furthermore, the module provides insight into why false information is spread,  
179 both consciously and unconsciously, and analyses how social media, messaging apps, and online platforms amplify its spread,  
180 particularly in the aftermath of disasters. Real-world cases from the 2023 Türkiye-Syria and the 2023 Morocco earthquakes  
181 illustrate these dynamics.

182 The module also addresses common earthquake myths. Students are presented with current knowledge on earthquake causes,  
183 forecasting, and induced seismicity, and are required to apply this knowledge through practical exercises. By contrasting  
184 misinformation with scientific explanations, students are encouraged to critically evaluate claims and to recognise the  
185 boundaries of current understanding.

186 The final section focuses on developing practical media literacy skills. Exercises extend beyond the context of earthquakes  
187 and promote transferable competencies for navigating digital information. This module helps students become better equipped  
188 to identify misinformation, understand its psychological appeal, and take responsibility for how they share and interpret  
189 information online.

## 190 **2.2 Raspberry Shake School Network Switzerland**

191 A second key outcome of the programme was the expansion of the *seismo@school* Raspberry Shake school network across  
192 Swiss schools. In the earlier SNSF-funded initiative, UNIL and CPPS installed 23 vertical-component (1D) Raspberry Shake  
193 geophones in the French-speaking cantons of Vaud and Valais, identified through newsletters from the cantonal Education  
194 Departments. With the new *Increasing Seismic Awareness in Switzerland* project, we were able to expand this network to 46  
195 secondary schools nationwide.

196 In Switzerland, the Swiss Seismological Service (SED) at ETH Zurich holds the official mandate for seismic monitoring and  
197 providing the public with earthquake information and warnings (Böse et al., 2024b). To fulfil this role, the SED operates a  
198 dense nationwide network composed of different modern seismometers and integrates near real-time data streams from  
199 neighbouring countries (Clinton et al., 2011; Cauzzi & Clinton, 2013; Diehl et al., 2025). The service is supported by  
200 professional scientific and technical staff on call around the clock to analyse seismic data and ensure reliable network and  
201 infrastructure operations. Given this framework, it is natural to incorporate the *seismo@school* Raspberry Shake instruments  
202 into the SED's monitoring infrastructure, despite their clear limitations compared to the high-quality sensors and digitizers  
203 normally deployed. The school-based devices are significantly noisier – especially during daytime hours when students and  
204 teachers are active in the buildings where they are installed – and occasionally underperform in time accuracy. However, care  
205 has been taken in their installation to avoid excessive noise.

206 A critical aspect of integrating the Raspberry Shake into the Swiss seismic network was maintaining control over the data  
207 flow. One of the main advantages of using Raspberry Shake instruments is their ease of setup and seamless integration into  
208 the Raspberry Shake ecosystem. However, this convenience comes with limitations: data is routed through Raspberry Shake  
209 servers and station names are constrained by their system. Also, the system may fail at any time and has failed in the past. To  
210 ensure full control of data flow and management, all Raspberry Shakes included in the *seismo@school Switzerland* project  
211 have a secondary stream to SED-ETHZ running a proprietary, but simple UDP protocol designed by Raspberry Shake. Data

212 is received by a seedlink plugin written by SED-ETHZ which converts the incoming data according to SED standards in respect  
213 to network, station, location and channel naming as well as MiniSEED formatting. It is then incorporated into established  
214 workflows for monitoring, archiving, distribution, and processing. In parallel, the data also continue to flow to the Raspberry  
215 Shake servers, ensuring full availability within their system.

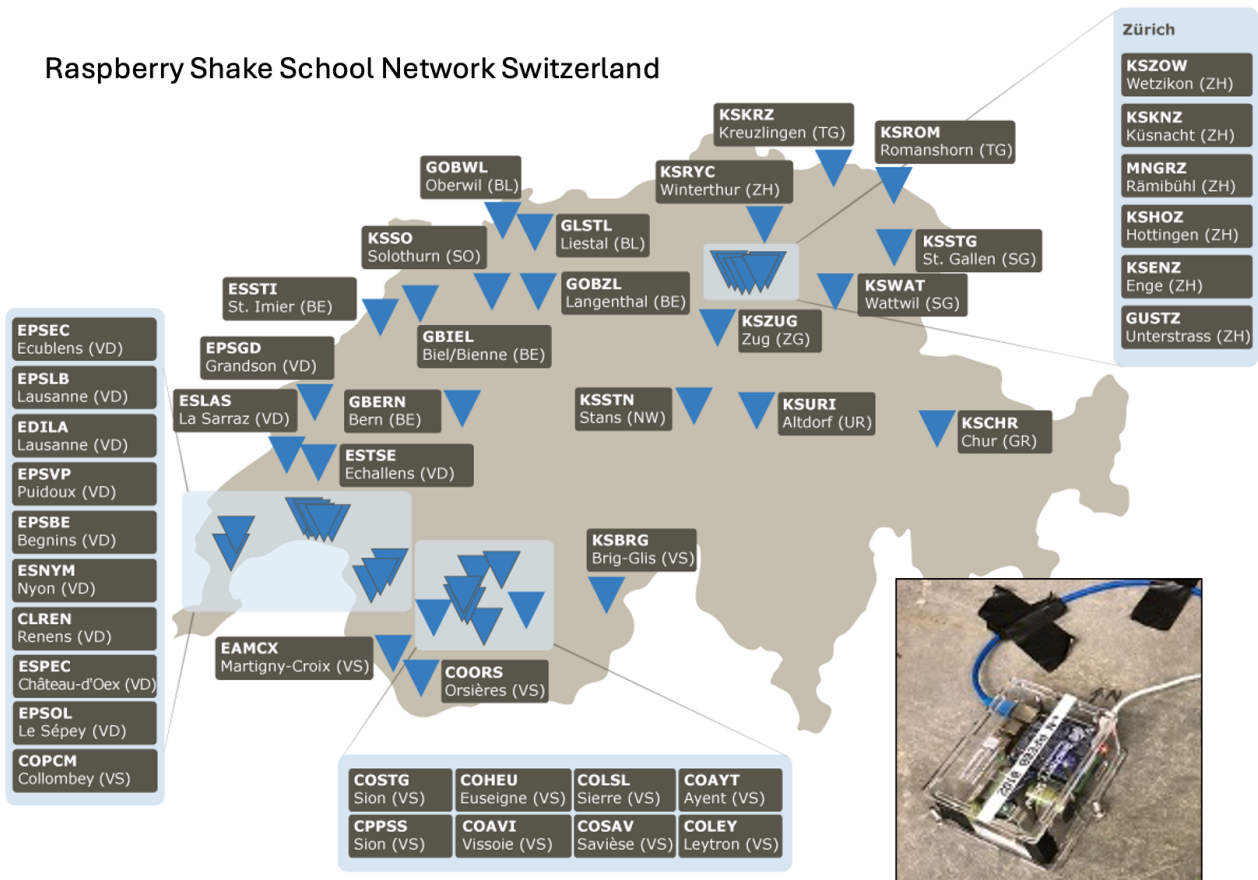
216 At the start of the project, we integrated the existing 1D Raspberry Shake school seismometers in Vaud and Valais into the  
217 SED monitoring infrastructure. In parallel, we identified new schools in other cantons from a survey conducted at the start of  
218 the project, using comprehensive email lists available at ETH Zurich. Schools expressing interest in hosting a Raspberry Shake  
219 were contacted via email with details on participation requirements. Once a school had accepted these conditions, we shared  
220 a detailed installation guide covering location selection, network configuration, sensor setup, and operation. We asked the  
221 schools to install the Raspberry Shake sensor directly on the ground, on a firm and level surface, away from vibration sources  
222 and ideally near a room corner. Installation in a basement and within a small building is preferable. The sensor should be  
223 connected to power and Ethernet and configured via a web interface with site details, data forwarding, and the SED-ETHZ  
224 server IP (preconfigured by us with the Raspberry Shake-specific port). Data should be sent to both the Raspberry Shake server  
225 and the SED-ETHZ server. For 3-component seismometers, the device should be oriented to north, levelled, and secured in  
226 place with cables marked to prevent movement. Schools were requested to document the installation, including site  
227 coordinates, building details, and photos, and send this information back to us. Most schools identified their sub-basements or  
228 server rooms as suitable locations, as these rooms are rarely used and generally have the necessary infrastructure. Schools in  
229 Vaud and Valais also favoured the school library or temporary teaching rooms, where students could more easily access the  
230 Raspberry Shakes with their teachers for in-class activities. We recommended teachers not to move the stations for teaching  
231 purposes, and this was very well respected.

232 For the initial installations, we visited schools in person to assist with setup, familiarize ourselves with the process, and identify  
233 potential issues to provide better guidance for subsequent schools. At later stages, when we were confident our documentation  
234 was sufficient to allow independent high-quality installations, we shipped the Raspberry Shake units by post. Before shipping,  
235 the standard SD cards in each unit were replaced with high-quality, industrial-grade 16 GB microSD cards, since SD cards are  
236 a common point of failure, particularly when the system is not properly powered down before unplugging. Each Raspberry  
237 Shake was also preconfigured with the appropriate port information, ensuring a straightforward setup process upon arrival.

238 A common challenge was ensuring that the Raspberry Shake could communicate continuously with the SED-ETHZ server  
239 through the school's network. Some schools experienced firewall restrictions that blocked outgoing or incoming connections  
240 required for data transmission. To address this, we provided detailed instructions on server and port configuration. Schools  
241 were encouraged to work with their IT departments to verify that the Ethernet connection could reach external servers without  
242 interruption. In some cantons, school IT is centrally managed by the Education Department, which requires additional  
243 coordination to overcome firewall issues. Unfortunately, firewall settings at many schools are reset during vacation periods,

244 which can temporarily block Raspberry Shake data transmission. To mitigate this, schools were advised to check connectivity  
 245 after holidays and, where possible, to coordinate with IT administrators to implement persistent firewall rules or automated  
 246 reconnection procedures. This, however, remained a challenge throughout the project.

247 Over a period of two years, we were able to install an additional set of 23 3-component (3D) Raspberry Shake geophones in  
 248 secondary schools across Switzerland (**Figure 1**). While we initially contacted schools based on our survey, interest spread  
 249 quickly, and additional schools reached out to participate. Due to the limited funding, we could not accommodate all requests  
 250 and had to be selective, also considering the need for a well-balanced network across the country. Schools that were unable to  
 251 receive a sensor were offered the option to collaborate with nearby participating schools or to purchase their own seismometer,  
 252 which could then be integrated into the *seismo@school* network. Despite several attempts, we have not yet been able to identify  
 253 a suitable school in the canton of Ticino, in the Italian-speaking part of Switzerland.



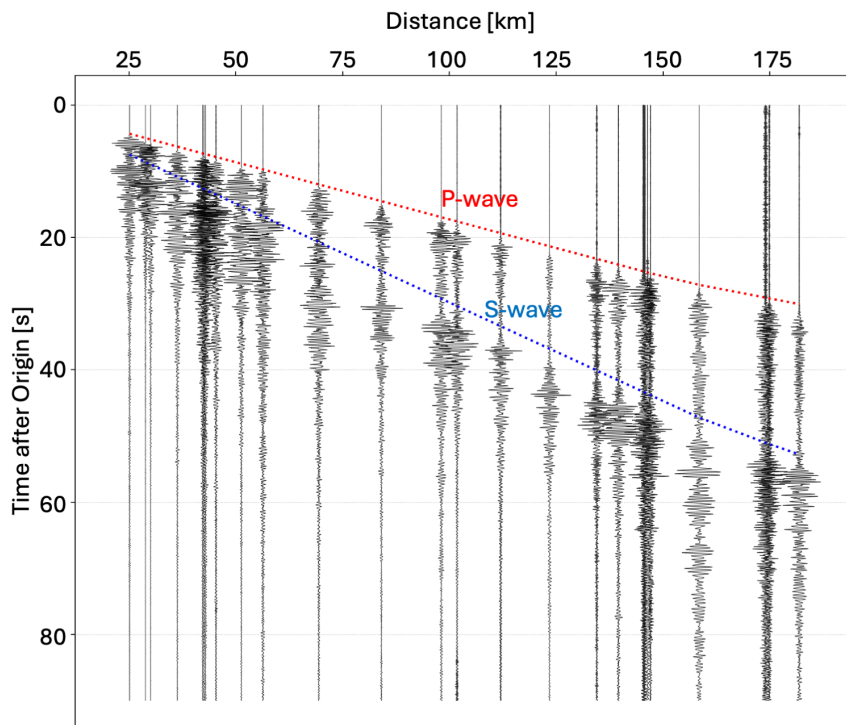
254  
 255 **Figure 1:** The Raspberry Shake school network Switzerland, as of today including 46 seismometers, deployed in secondary  
 256 schools throughout the country.

257 Students, teachers, and other users have unrestricted access to data from the Raspberry Shake stations. Data can be accessed  
258 via multiple platforms, including the Raspberry Shake DataView webpage, the ShakeNet mobile app, and the SED websites  
259 <http://sas-viewer.ethz.ch/> (local seismicity) and <https://rs-viewer.ethz.ch/> (local, regional, and global seismicity) (see **Data**  
260 **availability**). The project has a fully open data policy (see **Data availability**). For advanced users, such as students working  
261 on school projects, we provide a Jupyter notebook with example codes demonstrating how to access data through FDSN web  
262 services and how to visualize it. Our teaching module *Earthquake Monitoring and Raspberry Shake* (see **Chapter 2.1.2**)  
263 provides further guidance. To engage students and raise awareness of a newly installed Raspberry Shake, we encouraged  
264 schools to start with interactive experiments, such as gathering students around the sensor or in a neighbouring room to perform  
265 jump tests, for example with an increasing number of students, or by one person and decreasing distance to the seismometer.  
266 Several schools have also announced the Raspberry Shake installation in internal newsletters to promote interest and  
267 participation.

268 Power Spectral Density (PSD) analysis, computed daily at the SED for all stations (see **Data availability**), provides a  
269 quantitative framework for assessing the quality of seismic data from both high-quality SED stations and Raspberry Shake  
270 school seismometers. PSDs measure how seismic signal power is distributed across frequencies, allowing separation of natural  
271 seismic signals from anthropogenic noise. High-quality SED stations exhibit low, stable noise across both low frequencies  
272 ( $<0.1$  Hz, e.g., microseisms) and higher frequencies ( $>1$  Hz). In contrast, Raspberry Shake school seismometers show elevated  
273 noise above  $\sim 1$  Hz during school hours, caused by human activity, footsteps, and machinery. Lower-frequency signals ( $<0.1$   
274 Hz) are generally more reliable, but low-cost Raspberry Shake instruments are not optimal for measuring very long-period  
275 signals (e.g., periods  $>20$ – $30$  s) due to instrumental limitations. In general, above 1 Hz, the school seismometers are at or  
276 below the Peterson high-noise model (Peterson, 1993), and some stations are well below this level.

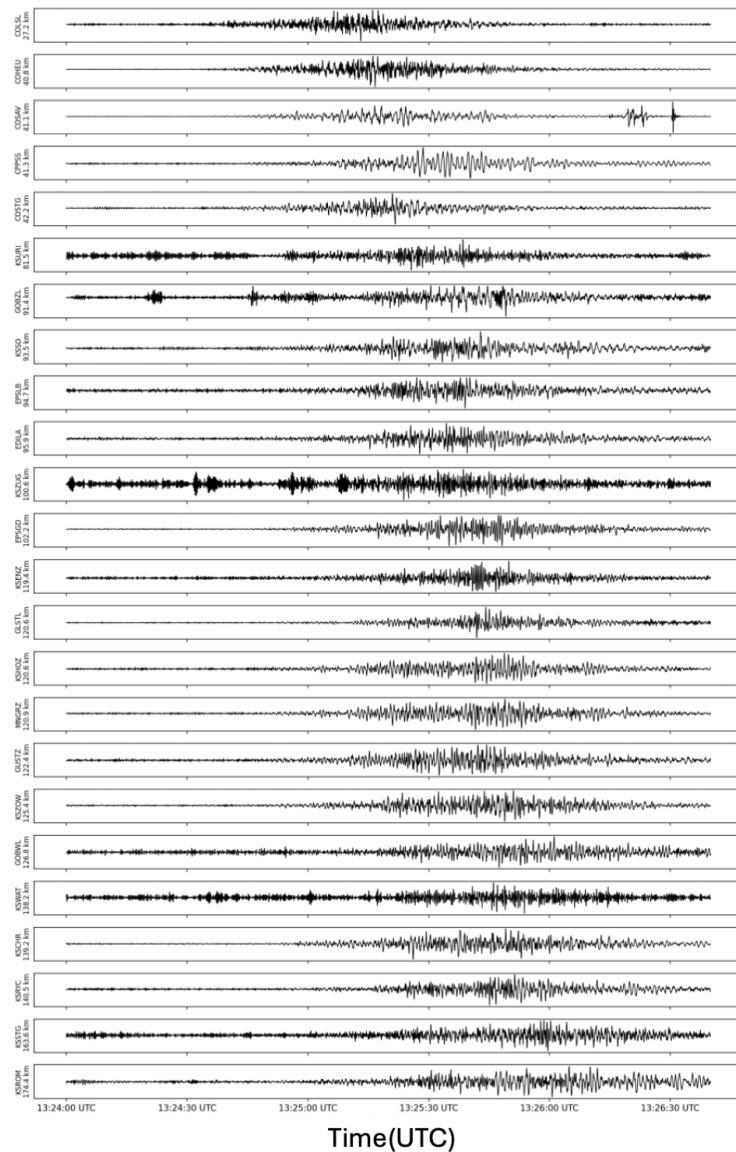
277 Despite their limitations, we found that the Raspberry Shake seismometers can generally detect local earthquakes of magnitude  
278 2.5 and larger at distances of up to  $\sim 330$  km – consistent with observations by Subedi et al. (2020) –, as well as moderate- to  
279 large-magnitude regional and teleseismic earthquakes, often even during noisy school days and more consistently at night, on  
280 weekends, or during school vacations (**Figure 2**). Although their primary purpose remains educational, yet the school  
281 seismometers have also proven scientifically valuable. While, by choice, they are not used for trigger-based detection or  
282 standard automatic locations at the SED, they are integrated into automated event-based machine-learning re-location  
283 pipelines, and 3-component station amplitudes contribute to automatic magnitude estimates. Additionally, the school sensors  
284 are used in manual solutions for picking P and S phases, determining P-wave polarity and magnitude. They are often important  
285 stations as they fill data gaps for depth estimation, focal mechanisms, and tomography. Notable events include a magnitude  
286 (MLhc) 3.0 earthquake near Zürich (Affoltern am Albis, July 30, 2025) and a series of small earthquakes near Ebnat-Kappel  
287 (June 2025), where Raspberry Shake seismometers provided valuable data, in particular for depth determination. Recently, the  
288 detection of a suspicious signal at a Raspberry Shake school sensor in the canton of Vaud in October 2025 even triggered the

289 search for the path of a meteorite entering the atmosphere that induced ground vibrations across western Switzerland (T. Kraft  
290 et al., personal communication April 2026).



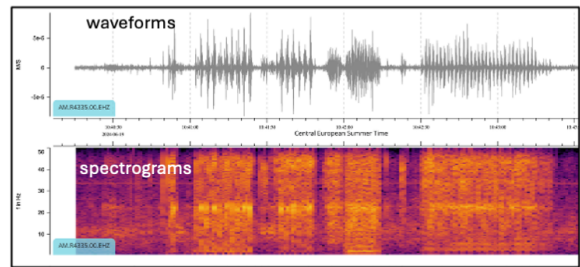
291  
292 **Figure 2:** Raspberry Shake school network recordings of the local 2024 magnitude (MLhc) 4.4 Sihltal earthquake. Red and  
293 blue dashed lines mark theoretical P- and S-wave arrival times based on the regional velocity model.

294 The Raspberry Shake school network allows students to monitor real-time seismicity directly from their classrooms, fostering  
295 a sense of ownership and engagement through active participation. Schools can investigate both local and global earthquakes  
296 using data from their own instrument and undertake small research projects – for example, as part of a *Matura* thesis, an  
297 independent research project carried out during the final year of upper secondary school in Switzerland (*Gymnasium*, *Lycée*,  
298 or *Liceo*). An important aspect of the Raspberry Shake is that they can record all types of vibrations, not just those from  
299 earthquakes. This includes traffic, sonic booms, concerts (e.g., the *Swift quakes* during a Taylor Swift concert in Zurich), and  
300 landslides. Mass movements are of particular interest in Switzerland, where their frequency has increased over the last decade,  
301 probably as a result of climate change. For example, a massive mass movement occurred in Blatten in Valais in southern  
302 Switzerland on 28 May 2025, equivalent to a magnitude (MLhc) 3.1 earthquake. Although this event occurred during school  
303 hours, it was well recorded by the entire Raspberry Shake school network across Switzerland beyond 175 km distance (**Figure**  
304 **3**). Schools found this particularly impressive, partly due to the strong media coverage, and the event was frequently used in  
305 lessons to discuss mass movements in the context of climate change and its impacts on Switzerland.



Mass movement in Blatten

Jump test



306  
307  
308  
309

**Figure 3:** Left: Raspberry Shake school network recordings of a massive mass movement occurred in Blatten in Valais in southern Switzerland on 28 May 2025, equivalent to a magnitude (MLhc) 3.1 earthquake. Right: ‘Jumping tests’ help students understand how seismometers record seismic events (© Marion Loher).

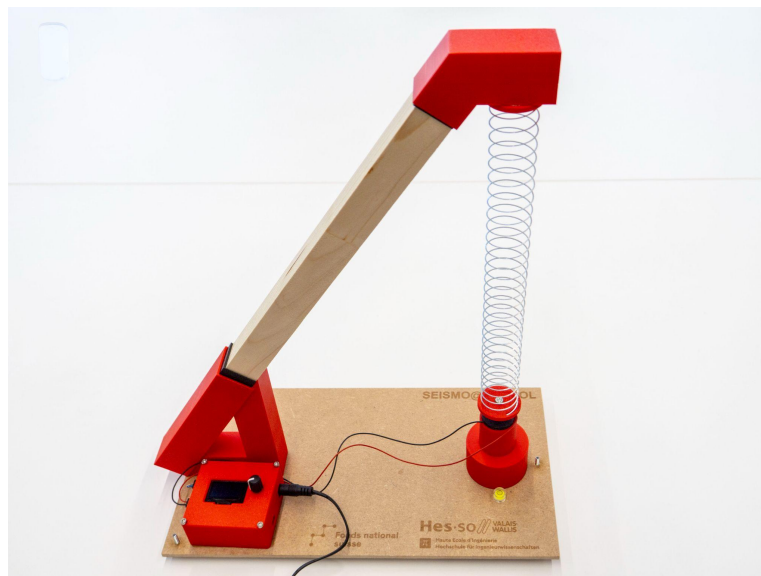
### 310 2.3 Exploratory Activities

311 To introduce students to the principles of earthquake detection, we developed a compact do-it-yourself seismometer kit for  
 312 schools - the *Lambda Slinky Seismometer* (**Figure 4**) -, named for its distinctive shape, as a third key outcome of the project.  
 313 The seismometer consists of a wooden base supporting a homemade coil, a load, and a box containing an Arduino and a screen

314 displaying real-time measurements. A gallows structure holds a Slinky spring with two magnets: one serving as the measuring  
315 element and the other for centring and damping. The instrument is designed to record both seismic events and classroom jump  
316 experiments. By turning a knob on the display unit, users can access the ten most recently recorded events, each showing the  
317 corresponding date and time.

318 The housing and mechanical components can be 3D-printed, while the electronic parts are standard and readily available  
319 online. The Arduino-based processor can easily be reprogrammed by teachers or students, allowing for further experimentation  
320 and adaptation to classroom needs. The device can be assembled in roughly 30 minutes with the support of a step-by-step  
321 video tutorial ([http://static.seismo.ethz.ch/sedvideos/seismo\\_school/tutorial\\_de.mp4](http://static.seismo.ethz.ch/sedvideos/seismo_school/tutorial_de.mp4), last accessed April 2026), making it  
322 accessible even for beginners. Once built, the seismometer reacts to small ground vibrations, such as footsteps or jumps, and  
323 displays the resulting signals in real time on an Arduino screen.

324 Although the kit is not intended for scientific research, it provides an engaging and tangible demonstration of how seismic  
325 instruments work. By letting students see their own movements converted into measurable signals, it bridges abstract concepts  
326 of ground motion with a hands-on learning experience. This playful approach captures curiosity while reinforcing the physical  
327 principles behind seismology. The project benefits from the so-called *IKEA effect*: learners feel greater attachment and  
328 motivation when they build the tool themselves, turning assembly into an integral part of the educational journey. By owning  
329 a physical device, the *IKEA effect* is most likely even stronger than owning “data” from one’s school seismometer. Around 20  
330 kits have been distributed to schools across Switzerland so far, expanding opportunities for classroom experiments.



331

332 **Figure 4:** The *Lambda Slinky Seismometer*, here already assembled (approximately 40 cm tall), for schools developed during  
333 the *seismo@school Switzerland* project.

## 334 **2.4 Teacher, Student and International Engagement**

335 The educational resources developed during the project were promoted and disseminated through teacher networks and  
336 educational events, reaching not only participating schools but also those without a seismometer. We organized several online  
337 and in-person workshops, engaging approximately 60 teachers in total, to familiarize them with the new educational materials  
338 and the Raspberry Shake seismometers. These workshops provided valuable opportunities for direct exchange with teachers,  
339 allowing us to gain insights into everyday school practices. Furthermore, we obtained a clearer understanding of the teachers’  
340 existing knowledge – what they already master and where gaps remain. Conversely, the teachers valued the opportunity to  
341 discuss their questions directly with experts and to gain insights into ongoing research projects. As a result of these workshops,  
342 additional schools contacted us, expressing interest in joining the *seismo@school* initiative. During these workshops and  
343 through follow-up email communication teachers were guided also on how to access and interpret Raspberry Shake data. For  
344 significant seismic events, we continue to provide seismograms and contextual background information. A recent survey  
345 indicated that many teachers have actively used these materials in their classrooms to discuss seismic events with students.

346 Beyond workshops, student visits to ETH Zurich and the supervision of Matura theses provided opportunities for motivated  
347 pupils to conduct original analyses. For example, one student developed a Dash app that visualizes data from the Raspberry  
348 Shake school seismometers for selected local earthquakes and provides an approximate animation of P- and S-wave  
349 propagation (<http://sas-viewer.ethz.ch/>, last accessed April 2026). Another project analysed seismic data recorded by a school-  
350 based Raspberry Shake seismometer to determine earthquake detection thresholds and identify anthropogenic noise sources.  
351 School classes can also visit *focusTerra* at ETH Zurich or the CPPS in Sion to complement their classroom learning with  
352 interactive exhibits on earthquakes and seismic phenomena. Both locations feature earthquake simulators that reproduce  
353 ground shaking, allowing students to experience earthquakes in an immersive and safe environment. Such simulators allow  
354 students to feel the ground motion associated with different earthquakes – an experience that is especially valuable in  
355 Switzerland, where large earthquakes are rare. By combining the direct physical experience with scientific explanations, these  
356 visits create a powerful and memorable learning experience that bridges theoretical understanding and real-world perception  
357 of seismic phenomena.

358 At the international level, our team actively engaged with the global educational seismology community. To exchange ideas,  
359 we conducted two online meetings in 2025 with participants from ten countries, including France, United Kingdom, Ireland,  
360 Ukraine, Germany, Nepal, New Zealand, Ecuador, and the United States of America. To further strengthen global partnerships,  
361 the team supported in April 2025 the 5th International Workshop on Educational Seismology in Nepal and its associated  
362 Earthquake Learning Exhibit (Subedi et al., 2026), organized to commemorate the 10th anniversary of the 2015 magnitude 7.9

363 Gorkha earthquake. The exhibition comprised 14 interactive modules, covering topics such as tectonic processes, seismic  
364 waves, building construction, and practical, location-based safety guidance on what to do *before, during, and after* an  
365 earthquake, as well as the installation of a seismometer. Approximately 2,000 pupils participated in this event. Pre- and  
366 post-event surveys of several hundred participating students revealed substantial improvements in knowledge, heightened risk  
367 perception, and increased intent to take preparedness actions. Subedi et al. (2026) highlight how the exhibition’s experiential,  
368 student-centred format effectively bridged scientific concepts and local realities to foster both individual and collective  
369 preparedness through education. However, sustaining the impact will require follow-up interventions, institutionalization  
370 through schools and local governance, and expanded training for teachers and volunteers. We propose that this model is  
371 scalable and could serve as a replicable framework for earthquake education programmes in other vulnerable regions.  
372 Regardless of the differences between Nepal and Switzerland, we aim to continue cooperation between the two countries for  
373 knowledge and experience transfer in the domain of educational seismology. The educational materials and modules developed  
374 during our project are currently being translated into Nepali for use within the local education system.

### 375 **3 Data and Methods**

376 Throughout the initiative (2023–2025), a combination of qualitative and quantitative approaches was used to monitor and  
377 enhance the effectiveness of the developed activities while also providing insights into the overarching research interest (see  
378 last paragraph in **Chapter 1**). This included two online surveys and a series of teacher workshops (May 2024, March 2025,  
379 and May 2025), which offered structured opportunities to gather detailed feedback and better understand teachers’ needs.  
380 Scientific accuracy was ensured through reviews by experts from the relevant fields.

#### 381 **3.1 Transdisciplinary approach**

382 The *seismo@school* initiative followed a transdisciplinary and iterative approach, bringing together teachers, partner  
383 organisations with extensive experience in knowledge transfer and outreach, researchers, and communication specialists. This  
384 collaborative framework ensured that all materials and activities were co-designed for practical and effective classroom use.  
385 Such an approach aligns with the principles of transdisciplinary research, which focuses on the active involvement of diverse  
386 stakeholders—not only scientists but also non-academic stakeholders such as teachers—who jointly frame the problems and  
387 generate knowledge (Lang et al., 2012; Pearce & Ejderyan, 2020; Jahn et al., 2012)

#### 388 **3.2 Online surveys**

389 The first online survey was conducted between July and August 2023 among 49 teachers of grades 7 to 12 in the German-  
390 speaking part of Switzerland. It provided an initial assessment of expectations and requirements regarding information  
391 materials on current earthquake topics, proposed exploratory activities and experiments, interest in RS seismometers and  
392 preferences for different teaching formats. The survey was created using Unipark (<https://www.tivian.com>, last accessed April

393 2026) and distributed via personal contacts and comprehensive email lists available at ETH Zurich. Participation was  
394 anonymous, and responses could not be traced back to individuals. Teachers could voluntarily provide contact details, if they  
395 were interested in receiving a seismometer, but these details were not linked to their answers.

396

397 A second online survey was conducted between August and September 2025 among participating teachers. Its aim was to  
398 assess the initiative's effectiveness, i.e. to gain a comprehensive understanding of how schools evaluated the activities and the  
399 provided teaching materials, in line with the overarching research interest. The questionnaire (see **Supplements**) comprised  
400 23 questions covering four areas: overall impression and reach, use of Raspberry Shake seismometer, the *Lambda Slinky*  
401 *Seismometer* and the developed teaching materials. The survey was created using Microsoft Forms (<https://forms.office.com>;  
402 last accessed April 2026) and distributed by email to all participants on 12 August 2025. Teachers had one month to respond.  
403 The questionnaire was available in both German and French and sent to approximately 44 recipients across participating  
404 schools. In total, 18 teachers responded, representing a response rate of 40.9%; two-thirds (67%) were German-speaking and  
405 one-third (33%) French-speaking. The survey was anonymous, with an option for participants to voluntarily disclose personal  
406 information at the end. All respondents were informed that the survey data would be use for the project's final report and for  
407 scientific research purposes.

## 408 **4 Evaluation of Activities**

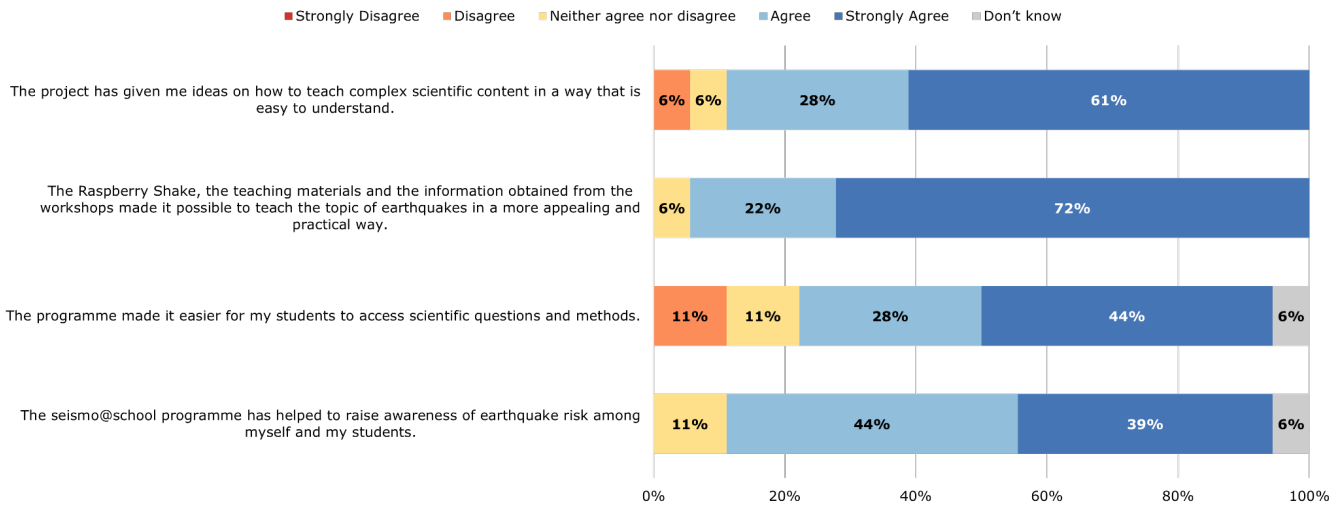
409 The following sections present the results of the second online survey, which provides the basis for the evaluation of activities.

### 410 **4.1 General Impression**

411 Most respondents (78%) rated their participation in the *seismo@school* initiative very positively, while 22% gave a neutral  
412 response. A large majority indicated that the initiative inspired their classroom teaching (89%) and helped raise awareness of  
413 earthquake risk among both students and teachers (83%). Overall, participants expressed a high level of satisfaction with the  
414 programme and considered it a valuable link between academic research and secondary education, promoting scientific  
415 thinking and strengthening awareness of earthquake risk in school (**Figure 5**).

416 Teachers' qualitative feedback emphasised the educational benefits of transdisciplinary collaboration between schools and  
417 scientific experts, particularly in terms of bridging the gap between scientific depth and practical classroom application. The  
418 teachers particularly valued the workshops and the regular email updates about recent earthquake detections or other  
419 phenomena recorded by the network.

**How much do you agree with the following statements about the *seismo@school* initiative?**



420

421

**Figure 5:** Results of the online survey (question 1) on various statements about the general impression of the *seismo@school Switzerland initiative*. Participants (n = 18) rated their agreement with four statements on a five-point Likert scale ranging from ‘strongly disagree’ to ‘strongly agree’. Percentages indicate the distribution of responses for each statement.

423

424

**4.2 Use of Raspberry Shake Seismometers in School Lessons**

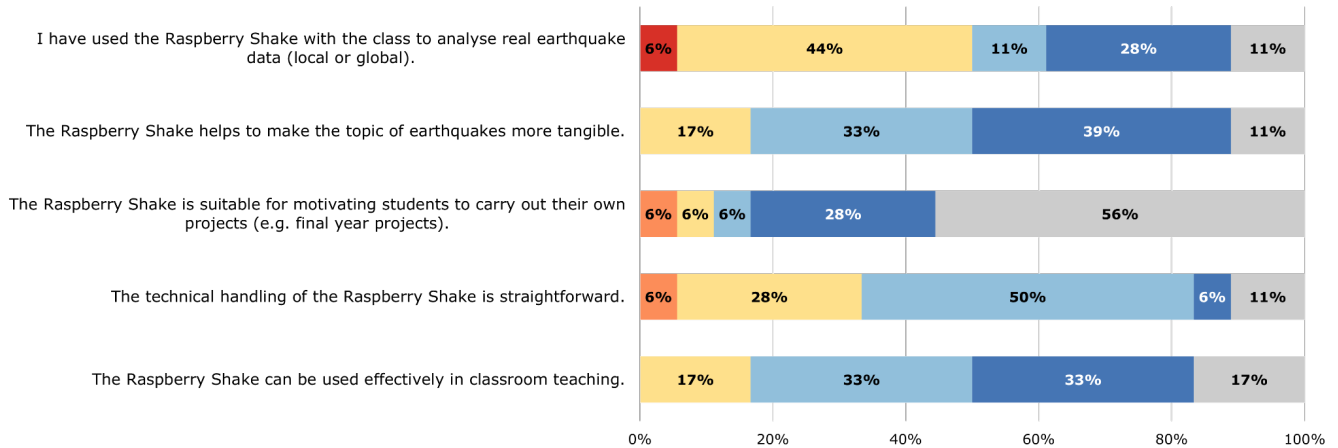
425

Survey participants reported having already used the Raspberry Shake with more than 955 students. Thirteen teachers (72%) agreed that the Raspberry Shake helps explain earthquakes more clearly, and two-thirds (66%) consider the seismometer well suited for classroom use. Although a smaller group of teachers (38%) reported using the device to analyse local or global earthquakes (**Figure 6**), several mentioned using the recordings of the Blatten landslide in May 2025 with their classes or incorporating them into activities such as jumping tests or other recorded vibrations (e.g., trucks, train traffic, or machinery). Some teachers also highlighted a couple of practical challenges and a need for additional guidance and technical support, particularly regarding data management and network connectivity.

431

**Please rate the following statements about the use of your *Raspberry Shake* seismometer**

Strongly Disagree Disagree Neither agree nor disagree Agree Strongly Agree Don't know



**Figure 6:** Results of an online survey on various statements regarding the use of Raspberry Shake seismometers in classrooms (question 8). Participants (n = 18) rated their agreement with four statements on a five-point Likert scale ranging from ‘strongly disagree’ to ‘strongly agree’. Percentages indicate the distribution of responses for each statement.

### 4.3 Teaching Materials and Seismometer Kit

The teaching modules were published online between spring and summer 2025. Two-thirds of survey participants (66%) had already viewed at least one module, but—given the short time before the survey and the start of the new school year—only about one-third (33%) had used them in class. Among those who viewed at least one module, more than 80% rated them as good or very good. Respondents valued the clarity of explanations, well-designed graphics, and the integration of realistic and locally relevant examples. Teachers found the materials adaptable and pedagogically sound, although some reported time constraints limiting full integration into their curricula.

By August 2025, we had distributed 21 *Lambda Slinky Seismometers* to schools across Switzerland (see **Chapter 2.3**). As additional kits remain available, we will continue to provide them to interested Swiss schools. Of the 18 survey respondents, 11 reported owning such a device, and just over half of them (54%) found it exciting to use them in their lessons. According to the comments, most teachers had not yet had the opportunity to use the device in class due to the summer holidays. A more detailed evaluation will therefore be possible at a later stage.

## 5 Discussions

The *seismo@school Switzerland* initiative demonstrates how experiential, data-driven learning can translate complex seismological concepts into meaningful classroom experiences. By combining real-time data with locally relevant examples, students engage in observation, experimentation, and interpretation, thereby strengthening both conceptual understanding and

452 scientific literacy. Although the initiative requires significant effort from scientists to support its implementation, its success  
453 depends primarily on effective knowledge transfer (through appropriate language and communication formats) rather than on  
454 overcoming scientific challenges. Teachers emphasized that collaboration with scientific experts effectively bridged the gap  
455 between research and school practice. This transdisciplinary approach aligns with the student-centred format advocated by  
456 Subedi et al. (2025), who emphasize that immersive, locally contextualized education can foster preparedness and strengthen  
457 the link between science and society. *Seismo@school* also aims to strengthen STEM education more broadly and may help  
458 counter the global trend of declining student interest in Earth sciences (e.g., Martinez, 2022) and related disciplines as future  
459 career paths.

460 While these findings highlight the project's potential to enhance science education, certain methodological limitations should  
461 be acknowledged. The survey conducted as part of the project provides an initial indication of its potential impact. Although  
462 the response rate of 40.9% is acceptable, the overall sample size remains limited, which restricts the generalisability of the  
463 findings. In addition, the survey period was relatively short, and many teachers will only implement the modules in the coming  
464 months. Repeating the survey at a later stage would therefore be advisable. Furthermore, it would be valuable to assess the  
465 direct impact on students (e.g., Subedi et al., 2025).

466 The integration of earthquake education in Swiss schools is shaped by *Lehrplan 21* ("*Study Plan 21*"), a joint curriculum  
467 framework developed during 2010-2014 and adopted by 21 German-speaking or multi-language cantons and the Principality  
468 of Liechtenstein for primary and lower secondary levels. Although *Lehrplan 21* promotes interdisciplinary, competence-  
469 oriented teaching across geography, natural sciences, and technology, earthquakes receive only limited explicit coverage. The  
470 situation is the same in the French-speaking part of the country and the *Plan d'Etudes Romand*. Implementation thus depends  
471 largely on cantonal priorities and individual teacher engagement. Survey responses indicated that most teachers devote only a  
472 few hours per semester to the topic, reflecting the limited curricular emphasis. The *seismo@school* resources and activities  
473 developed during our programme partly compensate for this gap by offering ready-to-use materials aligned with *Lehrplan 21*,  
474 which may enhance teachers' confidence and motivation to address the subject within existing time constraints. Expanding the  
475 number of instructional hours dedicated to earthquakes or natural hazards in official study plans would, however, require  
476 educational-political efforts involving multi-year negotiations, beyond the scope of short-term (two-year) projects.

477 The introduction of Raspberry Shake and *Lambda Slinky Seismometers* creates tangible connections between theory and  
478 observation, allowing students to collect and analyse real seismic data and (possibly unconsciously) benefit from the *IKEA*  
479 *effect*. This practical engagement promotes curiosity and reveals the potential of open data for inquiry-based science education.  
480 However, technical challenges – in particular regarding strict firewall settings in schools – highlight the need for ongoing  
481 guidance and institutional support including IT experts. Sustained collaboration with schools will be essential to ensure  
482 continuity and maintain data quality in classroom applications.

483 Beyond formal education, the initiative strengthens the interface between science and the public. Museum exhibitions, public  
484 events, and multilingual online resources expand access to seismological knowledge and foster dialogue about earthquake risk.  
485 By connecting classroom-based sensors to the national seismic network, *seismo@school* makes scientific data more accessible  
486 and transparent, thereby reinforcing public trust in research institutions. This participatory element aligns with broader citizen-  
487 science initiatives that link community engagement to shared awareness and resilience. The initiative aims for students to act  
488 as intermediaries of knowledge, fostering awareness of earthquake science and preparedness beyond the classroom and into  
489 their homes and neighbourhoods. This aspect can become an invaluable addition in countries located in high to very high  
490 seismic hazard levels. A clear challenge remains the mid- to long-term funding of such efforts. The most promising avenue  
491 for sustainability may lie in the development of appropriate policies on earthquake education (e.g., Hetényi & Subedi, 2023).

492 Although the *seismo@school* network was created primarily for educational purposes, the Raspberry Shake seismometers have  
493 become a valuable complement to Switzerland's professional seismic monitoring system. They help reduce spatial data gaps  
494 in the seismic network and enhance the characterization of local earthquakes. Moreover, integrating the Raspberry Shake  
495 sensors into the professional seismic monitoring network of the Swiss Seismological Service ensures regular quality checks,  
496 technical support, and long-term maintenance. In this way, both the schools and the professional network benefit. Overall,  
497 *seismo@school Switzerland* illustrates how a locally embedded, student-centred initiative can simultaneously advance seismic  
498 monitoring, scientific research, strengthen earthquake education, and enhance societal preparedness by raising awareness of  
499 seismic risk among young people and their families.

## 500 **6 Conclusions and Outlook**

501 The revival and expansion of *seismo@school Switzerland* demonstrate the value of combining formal education, citizen  
502 science, and professional monitoring in a single framework. Even in regions of moderate seismic hazard—but considerable  
503 risk—, sustained educational efforts are essential to maintain awareness of earthquake risk and to prepare society for rare but  
504 potentially damaging events, as well as for events people may face during travels to high-risk zones. The integration of real-  
505 time instruments, modular teaching resources, and international collaboration positions Switzerland as an active partner in the  
506 global educational seismology community.

507 This project has laid the groundwork for a sustainable, nationwide *seismo@school* initiative. In the near- to mid-term, the  
508 programme aims to continue supporting teachers and public engagement, expand the sensor network and learning materials—  
509 particularly to include lower secondary schools—and deepen partnerships with international school programmes while  
510 promoting Swiss-developed teaching materials abroad, for example in Nepal. Further efforts will focus on developing citizen  
511 science components, strengthening integration with cantonal Education Departments, and broadening the teacher network to  
512 include subjects such as physics, computer science, and mathematics. In parallel, collaboration within and among the Swiss  
513 academic institutions involved in the project will be reinforced, and links to other earthquake-related natural hazards, including

514 volcanoes and tsunamis, will be explored. The *seismo@school* network now forms a strong foundation for long-term  
515 collaboration between schools and Earth scientists in Switzerland. Participating in such a project as a scientist is both  
516 meaningful and rewarding: it enables the achievement of multiple milestones and often elicits enthusiastic feedback - beyond  
517 the inherent satisfaction of contributing to a societally relevant and useful initiative.

### 518 **Data availability**

519 Educational materials (available in English, German, French, and Italian) developed through this project can be accessed at  
520 <http://seismo.ethz.ch/en/news-and-services/for-schools/teaching-resources/> (last accessed April 2026). Schools and interested  
521 parties can easily access seismograms from the Raspberry Shake school network Switzerland ([http://seismo.ethz.ch/en/news-](http://seismo.ethz.ch/en/news-and-services/for-schools/raspberryschool-seismometer/)  
522 [and-services/for-schools/raspberryschool-seismometer/](http://seismo.ethz.ch/en/news-and-services/for-schools/raspberryschool-seismometer/)) via <http://sas-viewer.ethz.ch/> (local seismicity) and [https://rs-](https://rs-viewer.ethz.ch/)  
523 [viewer.ethz.ch/](https://rs-viewer.ethz.ch/) (local, regional and global seismicity) (last accessed April 2026). Data are also available for download from  
524 the European Integrated Data Archive (EIDA). The FDSN network code for the project is “S”  
525 (<https://networks.seismo.ethz.ch/en/networks/s/>). Seismologists can access the data using standard FDSN services operated by  
526 the SED: for example metadata at  
527 <https://eida.ethz.ch/fdsnws/station/1/query?network=S&format=text&level=sta&nodata=404> and waveform data can be  
528 accessed from the dataselect service, e.g. <https://eida.ethz.ch/fdsnws/dataselect/1/> (last accessed April 2026). Citation  
529 information: Swiss Seismological Service (SED) at ETH Zurich (2008), *Seismology at School Program, ETH Zurich*;  
530 <https://doi.org/10.12686/SED/NETWORKS/S>. Daily updated Power Spectral Density (PSD) plots for all Raspberry Shake  
531 school sensors (network code S) in Switzerland are available at <https://networks.seismo.ethz.ch/en/networks/s/psd/> (last  
532 accessed April 2026).

### 533 **Supplement**

534 Supplementary material includes the school evaluation questionnaire (see **Chapter 3**).

### 535 **Author contributions**

536 Conceptualization: MB, NV, GH, RRo, ID; Installation and operation of RS school network: MB, GH, NV, RRa, RRo, JC,  
537 UF, SS; Development and editing of teaching resources: NV (lead), ID, MB, GH, RRo, FH, MM, TJ, AS, KB; Development  
538 of exploratory activities: RRo; Development, conduct, and analysis of survey: NV; Writing - original draft preparation: MB,  
539 NV; Writing - review and editing: GH, RRo, ID, KB, JC, FH, MM, RRa, AS, SS, WS.

540 **Competing interests**

541 The authors declare that they have no conflict of interest.

542 **Ethical Statement**

543 This study did not involve human-subject research or the collection of personal data, since the survey could be conducted  
544 anonymous. However, participants were able to voluntarily enter their details at the end of the survey. These were not required  
545 for the evaluation at any time, nor were they passed on to third parties. Surveys were only conducted with individuals who  
546 were involved in or interested in the project. Due to these reasons, this study did not require formal ethical approval under  
547 Swiss guideline.

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562

563 **References**

- 564 Amashukeli, T., Farfuliak, L., Haniiev, O. and Petrenko, K.: Ukrainian Seismic Network: Current Status and Challenges,  
565 Seismological Research Letters, 95(4), 2038–2040, <https://doi.org/10.1785/0220230337>, 2024.
- 566 Berenguer, J.-L., Balestra, J., Jouffray, F., Mourau, F., Courboux, F. and Virieux, J.: Celebrating 25 years of seismology at  
567 schools in France, Geosci. Commun., 3, 475–481, <https://doi.org/10.5194/gc-3-475-2020>, 2020.
- 568 Butcher, T. A., Denton, D. A. and Williams, S. D.: The British Geological Survey School Seismology Project, Physics  
569 Education, 46(2), 174, 2011.
- 570 Braile, L., Hall, M., Taber, J. and Aster, R.: The IRIS education and outreach program, Seismological Research Letters, 74,  
571 503–510, <https://doi.org/10.1785/gssrl.74.5.503>, 2003.
- 572 Böse, M., Danciu, L., Papadopoulos, A., Clinton, J., Cauzzi, C., Dallo, I., Mizrahi, L., Diehl, T., Bergamo, P., Reuland, Y.,  
573 Fichtner, A., Roth, P., Haslinger, F., Massin, F., Valenzuela, N., Blagojević, N., Bodenmann, L., Chatzi, E., Fäh, D., Glueer,  
574 F., Han, M., Heiniger, L., Janusz, P., Jozinovic, D., Kästli, P., Lanza, F., Lee, T., Martakis, P., Marti, M., Meier, M.-A., Mena  
575 Cabrera, B., Mesimeri, M., Obermann, A., Sanchez-Pastor, P., Scarabello, L., Schmid, N., Shynkarenko, A., Stojadinovic, B.,  
576 Giardini, D. and Wiemer, S.: Towards a Dynamic Earthquake Risk Framework for Switzerland, Nat. Hazards Earth Syst. Sci.,  
577 24, 583–607, <https://doi.org/10.5194/nhess-24-583-2024>, 2024b.
- 578 Böse, M., Valenzuela, N., Dallo, I., Hetényi, G., Racine, R., Clinton, J. and Roduit, R.: Seismo@School – A Swiss-wide  
579 initiative to bring current earthquake knowledge to schools, 39th General Assembly of the European Seismological  
580 Commission, 22–27 September 2024, Corfu, Greece, 2024a.
- 581 Bravo, T., Taber, J. and Davis, H.: A Case Study of Highly-Engaged Educators' Integration of Real-Time Seismic Data in  
582 Secondary Classrooms. Front. Earth Sci. 8:180. doi: 10.3389/feart.2020.00180, 2020.
- 583 Cantore, L., Bobbio, A., Di Martino, F., Petrilio, A., Simini, M. and Zollo, A.: The EduSeis Project in Italy: An Educational  
584 Tool for Training and Increasing Awareness of Seismic Risk, Seismological Research Letters, 74(5), 596–  
585 602, <https://doi.org/10.1785/gssrl.74.5.596>, 2003.
- 586 Cauzzi, C. and Clinton, J.: A High- and Low-Noise Model for High-Quality Strong-Motion Accelerometer Stations,  
587 Earthquake Spectra, 29(1), 85–102, <https://doi.org/10.1193/1.4000107>, 2013.

- 588 Chen, K. H., Bossu, R. and Liang, W.-T.: Editorial: The Power of Citizen Seismology: Science and Social Impacts, *Front.*  
589 *Earth Sci.*, 8, 610813, <https://doi.org/10.3389/feart.2020.610813>, 2020.
- 590 Clinton, J., Cauzzi, C., Fäh, D., Michel, C., Zweifel, P., Olivieri, M., Cua, G., Haslinger, F. and Giardini, D.: The current state  
591 of strong motion monitoring in Switzerland, *Earthquake Data in Engineering Seismology: Predictive Models, Data*  
592 *Management and Networks*, 219–233, 2011.
- 593 Courboux, F., Bérenguer, J.-L., Tocheport, A., Bouin, M.-P., Calais, E., Dervaux, S., Virmoux, C. and Vincent, M. P.: Sismos  
594 à l'Ecole: A worldwide network of real-time seismometers in schools, *Seismological Research Letters*, 83(5), 870–873, 2012.
- 595 Crowley, H., Dabbeek, J., Despotaki, V., Rodrigues, D., Martins, L., Silva, V., Romão, X., Pereira, N., Weatherill, G. and  
596 Danciu, L.: European Seismic Risk Model (ESRM20), EFEHR Technical Report 002, V1.0.0, 84  
597 pp, <https://doi.org/10.7414/EUC-EFEHR-TR002-ESRM20>, 2021.
- 598 Dallo, I., Böse, M., Hetényi, G. and Roduit, R.: Seismo@School – A Swiss-wide initiative to bring current earthquake  
599 knowledge to schools, 21st Swiss Geoscience Meeting, 17–19 Nov. 2023, Mendrisio, Switzerland, 2023.
- 600 Dallo, I., Marti, M., Clinton, J., Böse, M., Massin, F. and Zaugg, S.: Earthquake early warning in countries where damaging  
601 earthquakes only occur every 50 to 150 years – The societal perspective, *International Journal of Disaster Risk Reduction*, 83,  
602 103, <https://doi.org/10.1016/j.ijdr.2022.103441>, 2022a.
- 603 Dallo, I., Corradini, M., Fallou, L. and Marti, M.: How to fight misinformation about earthquakes? – A Communication  
604 Guide, <https://doi.org/10.3929/ethz-b-000530319>, 2022b.
- 605 Danciu, L., Nandan, S., Reyes, C., Basili, R., Weatherill, G., Beauval, C., Rovida, A., Vilanova, S., Sesetyan, K., Bard, P.-Y.,  
606 Cotton, F., Wiemer, S. and Giardini, D.: The 2020 update of the European Seismic Hazard Model: Model Overview, EFEHR  
607 Technical Report 001, V1.0.0, <https://doi.org/10.12686/a15>, 2021.
- 608 Denton, P.: Seismology in schools: 10 years on, *Astronomy & Geophysics*, 49(6), 6.13–6.14, <https://doi.org/10.1111/j.1468->  
609 [4004.2008.49613.x](https://doi.org/10.1111/j.1468-4004.2008.49613.x), 2008.
- 610 Denton, P., Fishwick, S., Lane, V. and Daly, D.: Football Quakes as a Tool for Student Engagement, *Seismological Research*  
611 *Letters*, 89(5), 1902–1907, <https://doi.org/10.1785/0220180078>, 2018.

- 612 Diehl, T., Cauzzi, C., Clinton, J., Kraft, T., Kästli, P., Massin, F., Lanza, F., Simon, V., Grigoli, F., Hobiger, M., Roth, P.,  
613 Haslinger, F. and Fäh, D.: Earthquakes in Switzerland and surrounding regions during 2019 and 2020, *Swiss Journal of*  
614 *Geosciences*, 118, <https://doi.org/10.1186/s00015-025-00489-4>, 2025.
- 615 Diehl, T., Kraft, T., Kissling, E. and Wiemer, S.: The induced earthquake sequence related to the St. Gallen deep geothermal  
616 project (Switzerland): Fault reactivation and fluid interactions imaged by microseismicity, *J. Geophys. Res. Solid Earth*, 122,  
617 7272–7290, <https://doi.org/10.1002/2017JB014473>, 2017.
- 618 Fäh, D., Giardini, D., Kästli, P., Deichmann, N., Gisler, M., Schwarz-Zanetti, G., Alvarez-Rubio, S., Sellami, S., Edwards, B.,  
619 Allmann, B., Bethmann, F., Wössner, J., Gassner-Stamm, G., Fritsche, S. and Eberhard, D.: ECOS-09 Earthquake Catalogue  
620 of Switzerland Release 2011 Report and Database, Public catalogue, 17, 4, 2011.
- 621 Federal Office for Civil Protection (FOCP): National Risk Analysis Report. Disasters and Emergencies in Switzerland 2025,  
622 FOCP, Bern, 2026.
- 623 Grigoli, F., Cesca, S., Priolo, E., Rinaldi, A. P., Clinton, J. F., Stabile, T. A., Dost, B., Fernandez, M. G., Wiemer, S. and  
624 Dahm, T.: Current challenges in monitoring, discrimination, and management of induced seismicity related to underground  
625 industrial activities: A European perspective, *Rev. Geophys.*, 55, 310–340, <https://doi.org/10.1002/2016RG000542>, 2017.
- 626 Hetényi, G. and Subedi, S.: A call to action for a comprehensive earthquake education policy in Nepal, *Seismica*, 2(2),  
627 242, <https://doi.org/10.26443/seismica.v2i2.242>, 2023.
- 628 Hetényi, G., Subedi, S., Roduit, R., Valenzuela, N., Böse, M. and Sauron, A.: Programmes scolaires dédiés comme actions de  
629 science citoyenne: exemples du Népal et de la Suisse, *CitSciHelvetia'25*, 5–6 June 2025, Lausanne, Switzerland, 2025.
- 630 Jahn, T., Bergmann, M., and Keil, F.: Transdisciplinarity: Between mainstreaming and marginalization. *Ecological Economics*,  
631 79, 1–10, <https://doi.org/10.1016/j.ecolecon.2012.04.017>, 2012.
- 632 Lang, D. J., Wiek, A., Bergmann, M., Stauffacher, M., Martens, P., Moll, P., Swilling, M., and Thomas, C. J.: Transdisciplinary  
633 research in sustainability science: Practice, principles, and challenges. *Sustainability Science*, 7(1), 25–43.  
634 <https://doi.org/10.1007/s11625-011-0149-x>, 2012.
- 635 Löberich, E. and Long, M. D.: Follow the Trace: Becoming a Seismo-Detective with a Campus-Based Raspberry Shake  
636 Seismometer, *Seismological Research Letters*, 95(4), 2538–2553, <https://doi.org/10.1785/0220230365>, 2024.

637 Marti, M., Dallo, I., Roth, P., Papadopoulos, A. N. and Zaugg, S.: Illustrating the impact of earthquakes: Evidence-based and  
638 user-centered recommendations on how to design earthquake scenarios and rapid impact assessments, *International Journal of*  
639 *Disaster Risk Reduction*, 90, 103674, <https://doi.org/10.1016/j.ijdr.2023.103674>, 2023.

640 Martinez, S.: Geoscience enrollment and degrees continue to decline through 2021, *Geoscience Currents*, 172, American  
641 Geosciences Institute, <https://profession.americangeosciences.org/research/geoscience-currents>, 2022.

642 Mignan, A., Landtwing, D., Kästli, P., Mena, B. and Wiemer, S.: Induced seismicity risk analysis of the 2006 Basel,  
643 Switzerland, Enhanced Geothermal System project: Influence of uncertainties on risk mitigation, *Geothermics*, 53, 133–  
644 146, <https://doi.org/10.1016/j.geothermics.2014.05.007>, 2015.

645 Moein, M. J. A., Langenbruch, C., Schultz, R. et al.: The physical mechanisms of induced earthquakes, *Nat. Rev. Earth*  
646 *Environ.*, 4, 847–863, <https://doi.org/10.1038/s43017-023-00497-8>, 2023.

647 Paluszny, A., Schultz, R. and Zimmermann, G.: Induced seismicity in coupled subsurface systems, *Philos. Trans. A Math.*  
648 *Phys. Eng. Sci.*, 382(2276), 20230193, <https://doi.org/10.1098/rsta.2023.0193>, 2024.

649 Pearce, B., and Ejderyan, O.: Joint problem framing as reflexive practice: Honing a transdisciplinary skill. *Sustainability*  
650 *Science*, 15(3), 683–698. <https://doi.org/10.1007/s11625-019-00744-2>, 2020.

651 Peterson, J.: Observations and modeling of background seismic noise, U.S. Geol. Surv. Open-File Rept. 93-322, Albuquerque,  
652 New Mexico, <https://doi.org/10.3133/ofr93322>, 1993.

653 Sornette, A. and Haslinger, F.: Seismo at school in Switzerland, *EMSC Newsl.*, 24, 15, 2009.

654 Subedi, S., Hetényi, G., Denton, P. and Sauron, A.: Seismology at School in Nepal: A program for educational and citizen  
655 seismology through a low-cost seismic network, *Front. Earth Sci.*, 8, 73, <https://doi.org/10.3389/feart.2020.00073>, 2020a.

656 Subedi, S., Hetényi, G. and Shackleton, R.: Impact of an educational program on earthquake awareness and preparedness in  
657 Nepal, *Geosci. Commun.*, 3, 279–290, <https://doi.org/10.5194/gc-3-279-2020>, 2020b.

658 Subedi, S., Valenzuela, N., Dhami, P., Böse, M., Hetényi, G., Chardot, L., Adhikari, L. B., Bhattarai, M., Dhakal, R. P.,  
659 Houghton, S. and Upreti, B. N.: Organizing an Earthquake Learning Exhibition for transferring geoscience knowledge to the  
660 public: The example from Nepal, *Geosci. Commun.*, 9, 101–114, <https://doi.org/10.5194/gc-9-101-2026>, 2026.

- 661 Tan, M. L., Vinnell, L., Prasanna, R., Cui, A., Chandrakumar, C., Imtiaz, S. Y., Hong, B. and Viggers, Z.: CRISiSLab  
662 Challenge: Hands-on learning with Raspberry Shake seismometers, Poster abstract, QuakeCoRE Annual  
663 Meeting, <https://quakecore.nz/wp-content/uploads/2022/08/2022-Abstract-Book-FINAL.pdf>, 2022.
- 664 Wiemer, S., Danciu, L., Edwards, B. et al.: Seismic Hazard Model 2015 for Switzerland  
665 (SUIhaz2015), <https://doi.org/10.12686/a2>, 2016.
- 666 Wiemer, S., Bazzurro, P., Bergamo, P., Cauzzi, C., Dallo, I., Danciu, L., Duvernay, B., Fagà, E., Fäh, D., Hammer, C.,  
667 Haslinger, F., Kästli, P., Khodaverdian, A., Lestuzzi, P., Marti, M., Odabaşı, Ö., Panzera, F., Papadopoulos, A., Perron, V.,  
668 Roth, P., Schmid, N., Valenzuela, N. and Zaugg, S.: Earthquake Risk Model of Switzerland ERM-  
669 CH23, <https://doi.org/10.12686/a20>, 2023.
- 670 Zollo, A. and Bobbio, A.: The Educational Seismological Project: EDUSEIS, Seismological Research Letters, 71(5), 530–  
671 535, 2000.