

Increasing Earthquake Awareness: Seismo-at-school Switzerland

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

1 Introduction

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

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

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

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

59 To make this initiative a national programme, these institutions joined forces with the Swiss Seismological Service (SED) at
60 ETH Zurich (ETHZ) and other partners, which played a central role in expanding the network and offering further scientific
61 and operational expertise. Led by the SED, they launched the *Increasing Earthquake Awareness in Switzerland* project in May
62 2023, targeting 12–18-year-olds (Dallo et al., 2023; Böse et al., 2024a; Hetényi et al., 2025). This two-year project aimed to
63 revitalise and expand *seismo@school* Switzerland by providing schools with updated educational resources reflecting current
64 knowledge in seismology and related fields, Raspberry Shake classroom seismometers for earthquake recording, and a simple

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

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

87 2 Project Components and Implementation

88 2.1 Teaching Resources

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

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

106 resources were translated into German, French, Italian, and English, and made available through a dedicated SED
107 *seismo@school* webpage (<http://seismo.ethz.ch/en/news-and-services/for-schools/teaching-resources>, last accessed April
108 2026). The educational materials were promoted through (geography) teacher networks (e.g., online Teams groups),
109 workshops, and direct engagement with schools. The following sections provide a summary of each of the five modules.

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110 2.1.1 General Earthquake Knowledge

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

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

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

129 2.1.2 Earthquake Monitoring and Raspberry Shake

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

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

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

155 2.1.3 Earthquake Hazard and Risk in Switzerland

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

162 Following the general introduction, the module examines the distribution of earthquake risk across Switzerland, showing how
163 urban areas like Basel, Geneva, Zurich, and Bern face higher risk due to dense populations and concentrated assets (Wiemer
164 et al., 2023). Historical examples, such as the 1356 Basel earthquake, illustrate how the consequences of seismic events vary
165 over time, reflecting differences in urban development, construction standards, and possibly societal preparedness between
166 past and present contexts. Earthquake scenarios for various Swiss cities illustrate the potential damage in terms of building
167 damage costs, fatalities, the number of people seeking shelter, and other key indicators of societal disruption (Marti et al.,
168 2023). By comparing different scenarios and conducting an exercise using the SED *Earthquake Risk Tool*
169 (www.seismo.ethz.ch/earthquake-country-switzerland/risk/earthquake-risk-tool/, last accessed April 2026), students analyse
170 and discuss the various factors influencing risk in detail. Finally, the Swiss case is set within global and European contexts
171 (Danciu et al., 2021; Crowley et al., 2021). Comparisons with higher-hazard regions in southern Europe highlight
172 Switzerland's moderate hazard but significant risk due to infrastructure density. Interactive mapping tools from European

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

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2.1.4 Induced Seismicity

The *Induced Seismicity* module examines how human activities – such as mining, dam construction, fracking, wastewater injection, CO₂ storage, and deep geothermal energy projects – can trigger earthquakes (e.g., Moein et al., 2023). Although most induced events are small and pose minimal risk, some have caused significant damage, raising important safety and risk management concerns (Grigoli et al., 2017). Over recent decades, induced seismicity has become an increasingly prominent multidisciplinary field of research, integrating perspectives from engineering, geology, and social sciences (e.g., Paluszny et al., 2024). At the same time, these phenomena continue to provoke public and political debate. The module specifically investigates induced seismicity in the context of deep geothermal energy, exploring it through multiple disciplinary and societal lenses.

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

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

2.1.5 Misinformation and Media Literacy

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

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

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

215 2.2 Raspberry Shake School Network Switzerland

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

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

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

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

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

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

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

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

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297 Power Spectral Density (PSD) analysis, computed daily at the SED for all stations (see [Data availability](#)), provides a
298 quantitative framework for assessing the quality of seismic data from both high-quality SED stations and Raspberry Shake
299 school seismometers. PSDs measure how seismic signal power is distributed across frequencies, allowing separation of natural
300 seismic signals from anthropogenic noise. High-quality SED stations exhibit low, stable noise across both low frequencies
301 (<0.1 Hz, e.g., microseisms) and higher frequencies (>1 Hz). In contrast, Raspberry Shake school seismometers show elevated
302 noise above ~ 1 Hz during school hours, caused by human activity, footsteps, and machinery. Lower-frequency signals (<0.1
303 Hz) are generally more reliable, but low-cost Raspberry Shake instruments are not optimal for measuring very long-period
304 signals (e.g., periods >20 – 30 s) due to instrumental limitations. In general, above 1 Hz, the school seismometers are at or
305 below the Peterson high-noise model (Peterson, 1993), and some stations are well below this level.

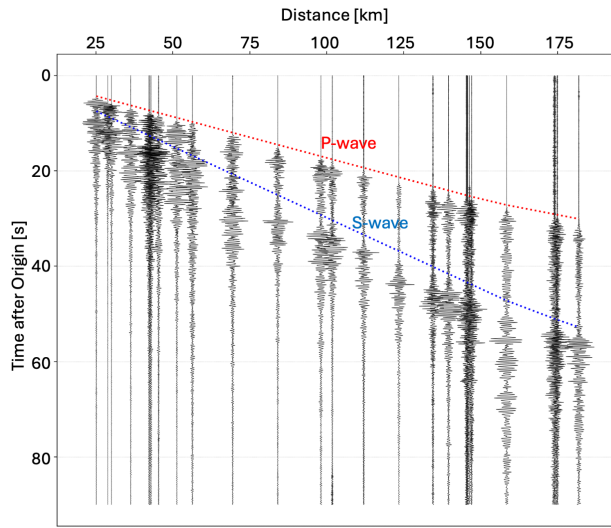
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306 Despite their limitations, we found that the Raspberry Shake seismometers can generally detect local earthquakes of magnitude
307 2.5 and larger at distances of up to ~ 330 km – consistent with observations by Subedi et al. (2020) –, as well as moderate- to
308 large-magnitude regional and teleseismic earthquakes, often even during noisy school days and more consistently at night, on
309 weekends, or during school vacations (**Figure 2**). Although their primary purpose remains educational, yet the school
310 seismometers have also proven scientifically valuable. While, by choice, they are not used for trigger-based detection or
311 standard automatic locations at the SED, they are integrated into automated event-based machine-learning re-location
312 pipelines, and 3-component station amplitudes contribute to automatic magnitude estimates. Additionally, the school sensors
313 are used in manual solutions for picking P and S phases, determining P-wave polarity and magnitude. They are often important
314 stations as they fill data gaps for depth estimation, focal mechanisms, and tomography. Notable events include a magnitude
315 (MLhc) 3.0 earthquake near Zürich (Affoltern am Albis, July 30, 2025) and a series of small earthquakes near Ebnat-Kappel
316 (June 2025), where Raspberry Shake seismometers provided valuable data, in particular for depth determination. Recently, the
317 detection of a suspicious signal at a Raspberry Shake school sensor in the canton of Vaud in October 2025 even triggered the

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

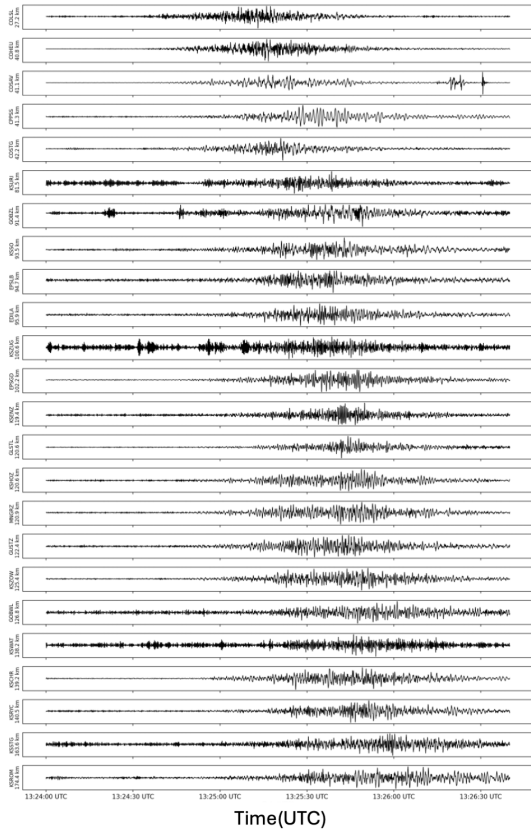
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323 **Figure 2:** Raspberry Shake school network recordings of the local 2024 magnitude (MLhc) 4.4 Sihltal earthquake. Red and
324 blue dashed lines mark theoretical P- and S-wave arrival times based on the regional velocity model.

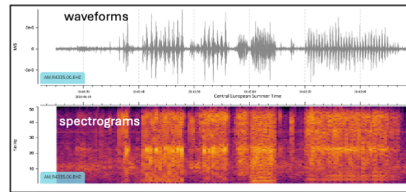
325 The Raspberry Shake school network allows students to monitor real-time seismicity directly from their classrooms, fostering
326 a sense of ownership and engagement through active participation. Schools can investigate both local and global earthquakes
327 using data from their own instrument and undertake small research projects – for example, as part of a *Matura* thesis, an
328 independent research project carried out during the final year of upper secondary school in Switzerland (*Gymnasium, Lycée,*
329 *or Liceo*). An important aspect of the Raspberry Shake is that they can record all types of vibrations, not just those from
330 earthquakes. This includes traffic, sonic booms, concerts (e.g., the *Swift quakes* during a Taylor Swift concert in Zurich), and
331 landslides. Mass movements are of particular interest in Switzerland, where their frequency has increased over the last decade,
332 probably as a result of climate change. For example, a massive mass movement in Blatten in Valais in southern
333 Switzerland on 28 May 2025, equivalent to a magnitude (MLhc) 3.1 earthquake. Although this event occurred during school
334 hours, it was well recorded by the entire Raspberry Shake school network across Switzerland beyond 175 km distance (**Figure**
335 **3**). Schools found this particularly impressive, partly due to the strong media coverage, and the event was frequently used in
336 lessons to discuss mass movements in the context of climate change and its impacts on Switzerland.



Mass movement in Blatten



Jump test



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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).

343 **2.3 Exploratory Activities**

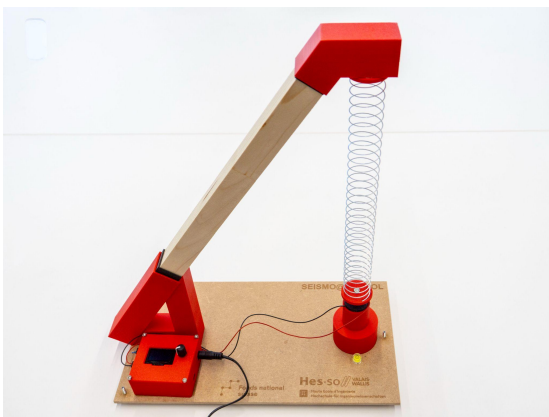
344 To introduce students to the principles of earthquake detection, we developed a compact do-it-yourself seismometer kit for
 345 schools – the *Lambda Slinky Seismometer* (Figure 4) –, named for its distinctive shape, as a third key outcome of the project.
 346 The seismometer consists of a wooden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

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

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

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



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

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372 2.4 Teacher, Student and International Engagement

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

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

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

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

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418 3 Data and Methods

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

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424 3.1 Transdisciplinary approach

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

431 3.2 Online surveys

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

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

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

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4 Evaluation of Activities

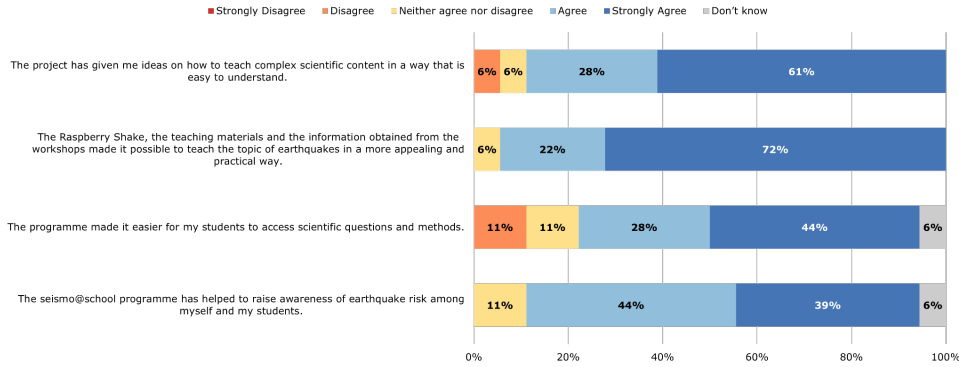
The following sections present the results of the second online survey, which provides the basis for the evaluation of activities.

4.1 General Impression

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

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

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



469

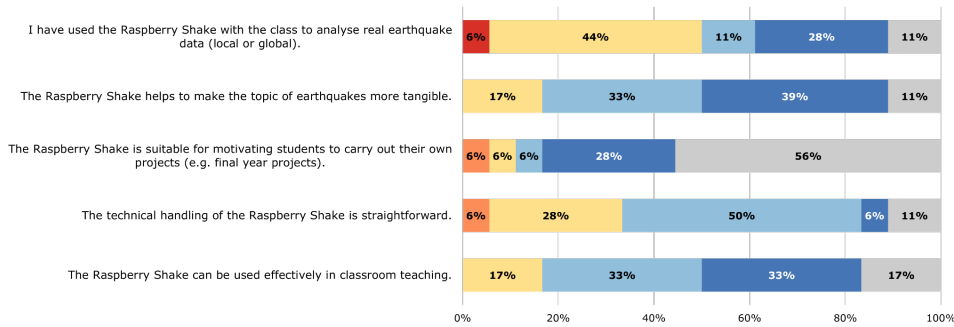
470 **Figure 5:** Results of the online survey (question 1) on various statements about the general impression of the *seismo@school*
 471 *Switzerland* initiative. Participants (n = 18) rated their agreement with four statements on a five-point Likert scale ranging
 472 from 'strongly disagree' to 'strongly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

473 **4.2 Use of Raspberry Shake Seismometers in School Lessons**

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

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



481

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

485 **4.3 Teaching Materials and Seismometer Kit**

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

492 By August 2025, we had distributed 21 *Lambda Slinky Seismometers* to schools across Switzerland (see **Chapter 2.3**). As
 493 additional kits remain available, we will continue to provide them to interested Swiss schools. Of the 18 survey respondents,
 494 11 reported owning such a device, and just over half of them (54%) found it exciting to use them in their lessons. According
 495 to the comments, most teachers had not yet had the opportunity to use the device in class due to the summer holidays. A more
 496 detailed evaluation will therefore be possible at a later stage.

497 **5 Discussions**

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

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

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

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

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

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

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

551 **6 Conclusions and Outlook**

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

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

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

569 **Data availability**

570 Educational materials (available in English, German, French, and Italian) developed through this project can be accessed at
571 <http://seismo.ethz.ch/en/news-and-services/for-schools/teaching-resources/> (last accessed April 2026). Schools and interested
572 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/)
573 [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/)
574 [viewer.ethz.ch/](https://rs-viewer.ethz.ch/) (local, regional and global seismicity) (last accessed April 2026). Data are also available for download from
575 the European Integrated Data Archive (EIDA). The FDSN network code for the project is “S”
576 (<https://networks.seismo.ethz.ch/en/networks/s/>). Seismologists can access the data using standard FDSN services operated by
577 the SED: for example metadata at
578 <https://eida.ethz.ch/fdsnws/station/1/query?network=S&format=text&level=sta&nodata=404> and waveform data can be
579 accessed from the dataset service, e.g. <https://eida.ethz.ch/fdsnws/dataset/1/> (last accessed April 2026). Citation
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582 school sensors (network code S) in Switzerland are available at <https://networks.seismo.ethz.ch/en/networks/s/psd/> (last
583 accessed April 2026).

584 **Supplement**

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

586 **Author contributions**

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

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600 **Competing interests**

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

602 **Ethical Statement**

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

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620 **[Review statement](#)**

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622

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