Engaging Schools and Communities in Geothermal Monitoring: Theoretical Framework and Case Studies from the DeepStor Research Infrastructure (Germany)

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A climate-neutral transformation of the heating sector is essential for the energy transition, and geothermal energy offers substantial potential to achieve climate protection targets. While the importance of the energy transition is widely recognized, deep geothermal projects often face challenges resulting from unfavorable public perception. Induced seismicity, in particular, raises public concerns and significantly influences social acceptance. Several factors contribute to these concerns, including inadequate or poorly communicated information about the complex scientific processes involved, ineffective dialogue between project developers and local communities, and limited opportunities for public participation in research or project development. To address these concerns, effective communication and active public participation in projects are identified as key solutions. This study presents a conceptual framework for participatory monitoring of geothermal projects and explore its influence on factors related to risk perception and technology acceptance. We focus on a citizen science approach that enables non-experts to actively participate in seismic measurements around a geothermal project through various formats, using plug-and-play seismometers. The individual, societal, and scientific implications of this approach are examined by integrating and connecting established sociological concepts within the context of deep geothermal energy. The conceptual framework is illustrated through a case study conducted within the DeepStor project, where Raspberry-Shake© seismometers serve as a central tool for fostering dialogue and collaboration with citizens and schools, enabling joint seismic data collection and hands-on learning experiences. We present results of initiatives where we are using the tool in educational projects and public science events, while preparing it for distribution to volunteers interested in contributing to the measurement network. The sociological and geophysical benefits of the initiative are discussed in relation to the conceptual framework. The findings of this study can provide guidance for a successful integration of participatory and co-creation approaches into geothermal research and industrial applications.