Seismographs in Schools Survey Summary
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Dr. Hilarie B. Davis, TLC Inc.
Tammy Bravo, IRIS

Executive Summary

After 20 years of the Seismographs in Schools program, data from a user survey shows that integrating seismic data into classroom lessons is engaging students in Earth Science learning. The 92 educators that responded spanned a wide range of grade levels. About half of the respondents (47%) teach grades 9-12, 27% teach 6-8, 11% teach K-5, 11% teach undergraduate, and 5% teach graduate school. Even with such a wide age range of students, teachers indicated spectrum of use of seismic data in the classroom and overwhelmingly valued the contribution the data make to their classroom and students.

Key results from the survey include:

- Teachers use seismic data in different ways: show the data to the class after an earthquake (83%), use the data to discuss earth science topics (73%), plot recorded earthquakes on a map (45%), encourage students to work with seismic data (42%), calculate distance (40%). calculate magnitude of at least 1 earthquake (28%), and other (21%).

- Teachers report high impact of seismic data on student subject knowledge on a scale of 1-10, with 1 being no impact and 10 being very high impact (8.2/10), on student learning (8.0/10), and on the quality of their curriculum (8.2/10).

- Teachers responded that they would like more instruction on using jAmaSeis (63%), seismometer hardware (61%), how to calculate the magnitude of a recorded earthquake (58%), how to locate the epicenter of a recorded earthquake (49%), advanced data analysis (46%), information about earthquakes they record (41%), how to determine if a recording is an earthquake (38%), and other (21%) such as calibration instructions, more filtering options, replacement parts, lesson plans for Mars seismic data, how to calculate depth of focus.

Teachers in the SIS program that responded to our survey are integrating seismic data into their classroom and report a positive impact on their students and program. To increase our impact, IRIS could expand professional development support for teachers in our program.

Background

The Incorporated Research Institutions for Seismology (IRIS) Seismographs in Schools (SIS) program has supported teachers in the use of educational seismometers and real-time seismic data in the classroom for the past 20 years. IRIS's SIS program serves teachers across the country and around the world using seismic instruments or real- time seismic data in K-16 classrooms. Additionally, the SIS site includes tools to share seismic data in real-time, classroom activities, and technical support documents for seismic instruments. IRIS began the SIS program with the goal of increasing the quality and quantity of earth science education in the classroom. While that is still the main goal of the program, the rapid advances of technology allowing easier access to real-time seismic data over the past 20 years have allowed the program to expand to reach a wider audience so that students and citizen scientists can be involved globally with or without access to a local seismograph.

Our SIS program developed and promotes jAmaSeis, a java-based program that allows users to obtain and display seismic data in real-time from either a local seismometer, a remote educational seismometer connected to the jAmaseis network, or any research-quality seismometer that streams data to the IRIS Data Management Center. Users can also filter data, fit a seismogram to travel time curves, triangulate event epicenters on a globe, estimate event magnitudes, and generate images showing seismograms and corresponding calculations.

Methods

We conducted an online survey of registered SIS educators to better understand how their seismographs and seismic data are being used in the classroom. The survey asked about their educational seismometer, seismic data use, software use, the impact of seismic data on their classroom, and what additional seismology-related resources or instruction they provide to

their students. This survey also served as an annual check-in for the SIS program, so identifiable data were collected. However, such data have been removed from this report.

The survey opened on October 2, 2019 and closed on October 30, 2019. A single survey invitation was sent to 770 SIS program participants who were currently or had been registered users in the IRIS SIS database. 92 educators responded to the survey (12% return rate).

The survey consisted of 11 questions including multiple choice, Likert-style, and free response questions. Survey questions are included in the Appendix.

Results

There were 92 respondents to the survey request geographically distributed between the US. and the UK (Figure 1).

Figure 1. Zip Codes of Survey Respondents

Characteristics of Respondents
The 92 respondents were mainly high school teachers (47%) and middle school teachers (27%), with a few K-5 teachers (11%), undergraduate faculty (11%), and graduate faculty (5%).

Grade Level	***N***	***%***
Graduate	3	5%
Undergraduate	7	11%
9th-12th	31	47%
6th-8th	18	27%
K-5th	7	11%

Most of have an educational seismometer (65% registered, 22% not registered).

Have a seismometer	***#***	***%***
Yes	60	65%
No	12	13%
I have a seismometer but not registered	20	22%

Impact
Using an unanchored scale from 1-10, where 10 is the highest impact, respondents report having seismic data in their classrooms as having a high impact on student subject knowledge (8.2/10), student learning (8.0/10), and on the quality of the curriculum (8.2/10).

Impact	*Min*	*Max*	*Average*
On your subject knowledge	3	10	8.2
On your students' learning	3	10	8.0
On the quality of your curriculum	2	10	8.2

Recommendations to Other Educators

Respondents would recommend using seismic data to other teachers to have students learn to: recognize earthquakes in streaming jAmaSeis data (77%), use jAmaSeis to look at an earthquake (79%), and upload and share data through the SIS website (61%).

Recommendations	Yes	No	Never Tried
Recognize earthquakes in streaming jAmaSeis data	71 (77%)	1	16
Use jAmaSeis to look at an earthquake	73 (79%)	0	14
Upload and share data through the SIS website	56 (61%)	6	22

Source of Seismic Data Used in the Classroom

The top three sources for seismic data in respondents' classrooms include their seismometer (57%), jAmaSeis (51%), and USGS (34%). Additional sources for some are IRIS SIS website (18%) and IRIS DMC (11%). Other sources cited were GeoNet, a personal homemade seismometer, Virtual Earthquake, Erasmus School Networks Alert Citizens (SNAC), SeisComP3 through Seedlink, Raspberry Shake 1D + SWARM, AS-1, and INSN – IDGL.

Source of Seismic Data	*#*	*%*
Classroom seismometer	52	57%
jAmaSeis	47	51%
IRIS DMC	10	11%
IRIS SIS Website	17	18%
USGS	31	34%
Other (please specify)	19	21%

Other responses (identifiable data removed from responses):

- *I try to locate all seismometers, gravimeters, accelerometers, infrasound, and any signal that might be correlated or related to events.*
- *GeoNet*
- *Personal Homemade Seismometer*
- *We used to have Amaseis software. We also had software showing P, S and surface waves for some earthquakes. We also used to have software for the historic occurrence of earthquakes across the globe. These helped the students engage with the subject. Since the upgrade for our seismometer last year, this software was removed but I would be interested in getting it back or indeed in new programs to assist student understanding of earthquakes.*
- *Nothing right now, but we're interested in how we mitigate effects of earthquakes with seismography*
- *Old lessons that had seismograph data Virtual Earthquake*
- *NOA Seedlink Plugin Seiscomp3*
- *We have a short period seismometer with a drum recorder*
- *Real time Seedlink plug-in for TC1 and Raspberryshakes running on Seiscomp 3*
- *Raspberry Shake 1D + SWARM*
- *AS-1*
- *INSN – IDGL*
- *Raspberry Shake running alongside AS-1*
- *I have a nonfunctioning AS1(used to work GREAT!) an infiltec that picks up classroom vibration. Just installed a Raspberry Shake and am in that network.*

Activities Teachers Do with Seismic Data

Respondents report using seismic data in to show the data to the class after an earthquake (83%), to discuss Earth science topics (73%), to encourage students to work with the data (42%), to plot recorded earthquakes on a map (45%), to calculate

distance (40%), and to calculate magnitude of an earthquake (28%). Other uses included educating adults, reporting data on their Facebook page, using data to find epicenters, posting data on school website, and present at state science conferences.

Activities with Seismic Data	***#***	***%***
Show the data to the class after an earthquake	76	83%
Use the data to discuss earth science topics	67	73%
Encourage students to work with the data	39	42%
Plot recorded earthquakes on a map	41	45%
Calculate distance	37	40%
Calculate magnitude of at least 1 earthquake	26	28%
None of the above	4	4%
Other (please describe)	19	21%

Other responses (identifiable data removed):

- *I'm not a teacher, but I do educate my friends and share your site to help them follow earthquakes and gain a better understanding of the processes that drive them.*
- *There are many partial and failed student and school programs globally. I have no particular project to connect them, but I am trying to find low cost sensors that can be linked globally, regardless of country or grade level. I see no reason a 4th grader cannot use online tools to explore the world. I use that when I estimate "accessibility" on Internet websites. If NASA, for instance, puts massive amounts of data online in lossy formats, and with no way to trace exactly how the data came to be - with tools that are available to anyone with a basic browser -- I grade them rather low and tell them it is better if they remove it until they are ready to do it for the whole world, not just experts and ones using proprietary or limited access tools. That sort of thing.*
- *there is a major or local earthquake I send the teacher a power point of the event with description and map. Also the seismometer display is above the reception desk for the school, so visitors and faculty are aware of major events.*
- *Awareness and showing Earth and Spce Sci, as well as Geo glasses how it works*
- *I report it on my FB account*
- *Would love to do all of that if I was able to*
- *still trying to get it working - would love to be part of this.*
- *In the past we also used the software showing the P,S and surface waves for a well know earthquake. We also used to look at historic earthquake occurrence using software that came with the seismometer when we got it installed. However, these programs are no longer on our computer for the seismometer since its upgrade last year.*
- *Using data to find epicenter (Virtual Earthquake)*
- *There are sometimes extraneous readings on jAmaSeis that are not earthquakes, such as students walking in the building during passing period, high winds blowing through a leaky building, trains coupling, etc. I like to ask the students if they have any idea what would cause these differences in the readings.*
- *recently revived SEP seismometer.*
- *We calculate earthquake distances and epicenters, but not the exact ones that we have recorded*
- *I teach 9th grade and a college level course. The college level students work with the data more than the 9th grade students. I also send out school wide email messages with data and news reports attached after large earthquakes.*
- *Make fake earthquakes to test software and to see how sensitive it is.*
- *explore wave propagation, attenuation, dampening and resonant frequency; teach and explore how to make/read linear and log-linear plots*
- *TC1 vertical seismometer really needs to be calibrated for calculating magnitudes. Many of our seismograms are teleseismic as well as local.*
- *Share data on my Facebook page*
- *I have done first-motion studies with my physics students to plot fault-plane solutions. I love teaching about those beach-balls!*
- *Present on seismology topics at state science teacher conferences.*
- *Encourage students to use seismic data with their science research projects*
- *Help students understand how seismometers work. We usually create a "human earthquake" by having the whole class jump.*
- *With my elementary students, we mostly do low-level inquiry (what's that? what happens when we all jump near it? how can you tell if there's an earthquake?). It's really used as an entry point to conversations.*
- *Make data available to others and am able to speak to organizations and classes about seismic events and earth science.*
- *we look at current earthquakes, but not data from my machine. before I had a technical problem, it was great, but I just cannot get help to get it up and running again*

- *I can only access the seismograph tracings. I have never been able to extract or plot anything.*
- *Use data in lessons, kids from all over the school come to see when we have an event that is notable. It's a big deal here!*
- *Have greatly missed having AS1 functioning in my room.*

Educators Interest in Additional Instruction
More than half the respondents indicated they would like additional training on one or more topics such as the hardware, jAmaSeis, seismology topics, and seismographs.

Additional Instruction	***#***	***%***
Seismometer hardware	56	61%
Using jAmaSeis	58	63%
Information about earthquakes I record	38	41%
How to determine if a recording is an earthquake	35	38%
How to locate the epicenter of a recorded earthquake	45	49%
How to calculate the magnitude of a recorded earthquake	53	58%
Advanced data analysis	42	46%
Other (please describe)	19	21%

Other responses (identifiable data removed):
- *I am not using this software. I was visiting to see if it would be useful to new sites. You might want to monitor visitors and not trigger the survey until people have time to visit for a while, or maybe a few times.*
- *I am a seismologist, so I already know these things.*
- *The program I have doesn't work anymore for running the seismometer.*
- *I would love to have SIS in my school! Would be happy to add NC to the network*
- *How to Calculate DEPTH of FOCUS*
- *Anything new since I first go trained back in 2009.*
- *How to share data with others in the network*
- *How would our school get set up with a seismometer?*
- *Help in sharing our jAmaSeis data (real time image) via the Internet. Our District is very stingy with ftp access and as I understand it, that is the only way to share data.*
- *Any help would be most appreciated. We are running this as a display now.*
- *We need more information on how magnitudes and foci are calculated. It would be good if jAmaSeis was able to calculate an acceptable magnitude using a TC1.*
- *Still using Amaseis, would like to know if it is beneficial to switch. I have the ability to upload data now, but I'm not sure how to do that.*
- *My school was part of an environmental disaster due to mold in the building. My seismometer was dismantled during the cleaning process and parts were lost. If I could get replacement parts or told where I could by them it would be helpful. Also, I was having trouble with getting a complete trace in jAmaSeis and had to revert to using Amaseis so I had to stop sharing my seismometer on the network. Help trouble shooting that would be appreciated, too*
- *More filtering options in jAmaSeis*
- *I would love to see lesson plans and lesson ideas for using Mars seismic data in the classroom.*
- *Finding the magnitude using SEP seismometers*
- *Upgrade my digitizer to have the correct year, month, and date recorded on my quake files.*
- *Clear instructions for calibration*

Specific Resources Educators Report Would Increase Their Impact
More than half of respondents reported no needs (55%). Needs identified by the others included using the software better, getting hardware working or located better, training (see specifics below), media and resources about topics.

- *None (51)*
- *Just the above additional instructions (2)*

Hardware
- *A refresher course on using the machine!*

- *A dedicated computer lab*
- *More online seismometers (DMC)*
- *We have had trouble off and on getting the computer and device to work.*
- *My school will not let me have my computer connected to the server to run live screen time or connect to the internet.*
- *I also need a new Black Box!!!*
- *Dry erase boards with markers/erasers*
- *I would like to have a classroom seismometer station.*
- *A way to use this wirelessly?*
- *I've asked for more seismometer accounts but haven't received any. I go to schools and give presentations on seismology. I would like to donate slinky seismometers and leave them in the classroom so the students can see earthquakes being recorded. This would require me having more than one account (I don't want to have to explain to teachers how to set one up).*
- *The electronic box is finicky and hard to get reliable data. We need a new unit, per conversations with IRIS.*
- *My problem at the moment is finding a good location to place the seismometer.. I am also having computer problems with the computer logging out and we lose data.*
- *Get my AS1 up and working again (2)*
- *Hopefully the Raspberry Shake will work as well as my old AS1.*
- *Clear instructions for calibration*

Software

- *The Amaseis program*
- *Being able to just print the event, like before. Having the globe and all the other stuff is distracting.*
- *Help troubleshooting jAmaSeis*
- *I would love to be able to access the globe feature to show the location of the EQ in relation to the plate boundaries.*
- *A refresher course on using software!*

Media

- *Videos of seismic processes*
- *A poster describing the working, and the differences between this device and three axis seismos*
- *More short videos about seismology and also plate tectonics and volcanoes*
- *Animations*

Resources

- *Training (4)*
- *A guide book on how to interpret jAmaSeis data for school students.*
- *I am not very good at reading the earthquake data to determine which type of waves occur when.*
- *I found the supplementary information provided when the seismometer was installed was useful. This included seismograms for some well know earthquakes.*
- *Setting up a Seismograph depending on expense and time required*
- *More time to dedicate to seismicity and earthquake parameters*
- *Better help desk; Virtual Seismometer app*
- *I would like to know more about how to calculate magnitude from the data*
- *Interested in more training on filtering and ID and analysis of wave modes.*
- *More BOSS models - Building Oscillation* ***Seismic*** *Simulation,*
- *Updates to 2004 workshop materials I have*
- *A PowerPoint that goes over the basics of how earthquakes are recorded at an upper elementary level*

Data

- *Real-time kml files to use with google earth*
- *EIDA archive; software Seisgram2k or SWARM*
- *Models of the earth interior, faults and bathymetry with the possibility of international shipping.*

Community

- *Document all the student geophysical networks and build a site that allows any school interested to join and contribute. There are many such group sites, but they are not working together. Get all the teachers at a grads level working together.*

Questions or Suggestions for the Seismographs in Schools Program

42% of respondents did not have any suggestions (39). Suggestions from other included wanting more ways to connect to other teacher and seismologists, training, software for mobile devices, help with hardware, and resources for curriculum, support and yearly check ins.

- *None (39)*

Community

- *Do not limit yourself to one country or one grade level. Accept and reach out to everyone - all countries all ages.*
- *Would like to know if funding is available so that I can join the program.*
- *Is there a way to promote this on social media?*
- *A newsletter perhaps a couple of times per year would be useful.*
- *How do schools become part of the program? Is it used in many 4th grade classrooms? given Earth Science curriculum, seems like a natural? What does it cost to participate?*
- *How could we share educational material*
- *This seismometer installation has a positive impact on students and faculty at the school because the display is in a prominent place*
- *Have a forum page so that managers and students can talk to each other and develop resources especially for formative assessment tasks*
- *More contact with the teachers during the school year. Sometimes we feel left out to dry.*
- *Is it possible to organize international conferences to share our experiences and learn from each other? This can also help to start collaboration projects between countries.*

Training

- *I think that the in-depth presentations made by IRIS in the past for schools after a major earthquake occurs is very useful for students when studying the global picture.*
- *How to locate earthquakes on east coast*
- *A refresher course would be great on analyzing an earthquake using jAmaSeis. We have a new teacher in our Earth Science department and she could additionally use training.*
- *Any chance of having an advanced workshop?*
- *More training on jAmaSeis*
- *Another workshop to refresh skills (3)*

Hardware

- *Our seismograph is at the public library. How do I access the data it is collecting?*
- *It's a very steep entry curve! any simple help for non-technical teachers would be gratefully received.*
- *Need help connecting to the network to share my data/feed*
- *Yearly visits by experts to check on equipment.*
- *Files (maybe a pdf) with schematic and printed circuit board for the electronics of the seismometer*
- *More flexibility in moving educational seismometers to teach additional lessons about how to choose a location for it, site condition effects, monitoring local microseismicity*
- *Have not been able to connect to SIS. Replacement parts availability*
- *It would be cool to get more hardware out there!*
- *The digitizer connecting the coil output of the SEPUK-1 is much better than the older serial data connector; many schools might need these to simplify data collection.*
- *I would love to add another AS-1 (at my cost) to our other middle school in our district, which is located about 7 miles away, so that we could compare and contrast like instruments in proximity to each other.*
- *How can I get the AS1 working and recording data again?*
- *Even though my classes don't spend a lot of time going into details about seismology, the seismograph is helping my young students be more interested in earth science.*

Software

- *Any chance of an iOS or Android version of jAmaSeis in the future? Any possibility of developing a horizontal AS-1 to complement the vertical models currently used? An app for iPads would be helpful.*
- *Set up jAmaSeis to just print an extracted event, without the globe and circles on it*

- *An easy way to determine which waves are which on a seismogram. Should be able to input our location and be able to get exact arrivals of p, s and other waves from recent quakes.*
- *It would be great if there was some sort of weblink for real-time screenshots from our station that could be placed on our website to display our readings.*

Resources

- *Better responses to my inquiries (5)*
- *Curriculum should contain seismic waves and earthquake parameters*
- *A yearly check- in with a seismologist at the school to tweak what we are doing would be a great help.*
- *Continue with the teachable moments. They are outstanding!*

Interest in a Seismology-Based Contest

The contest would be with international schools (France, UK, Switzerland) and involve a little bit of internet research and a hands-on project every two months for students to learn more about the InSight Mission to Mars.

Interest	*#*	*%*
Yes	25	27%
No	25	27%
Maybe	42	46%

Issues

Please let us know if you have equipment to return, need new electronics, we removed your station from the database by mistake, or have another major issue you would like us to email you about.

Responses (identifiable data removed from responses):

- *Not at this time (54)*
- *Please contact me about (38)*

Conclusions

A sample of seismograph users (N=92) from different grade levels (K-graduate school) reported that the program engages students in seismology and using data in general. The educators value the program and would recommend it to other educators. They would like more of a community of educators, more training, and more seismographs! They would also like more support for using the software and troubleshooting the hardware. Mobile versions of the software were also suggested. These additions could perhaps engage more of the educators to use their seismographs and seismic data; only half use the jAmaSeis software and less than half encourage students to work with the data. Further study of active users may reveal what else engages and supports teachers in using seismic data in the classroom.

Appendix

* 1. Please update your contact information

Name

School/Organization

Zip Code

Grade Level

Email

* 2. Do you have an educational seismometer registered in our database?

- I have a seismometer but I am not registered
- No
- Yes, my Station Code is

Seismic Data

* 3. What is the source of seismic data you use in the classroom?

- [ ] Classroom seismometer
- [ ] jAmaSeis
- [ ] IRIS DMC
- [ ] IRIS SIS Website
- [ ] USGS
- [ ] Other (please specify)

* 4. I do the following in a given school year with seismic data (check all that apply)

- [ ] Show the data to the class after an earthquake
- [ ] Use the data to discuss earth science topics
- [ ] Encourage students to work with the data
- [ ] Plot recorded earthquakes on a map
- [ ] Calculate distance
- [ ] Calculate magnitude of at least 1 earthquake
- [ ] None of the above
- [ ] Other (please describe)

Other

* 5. Rate the impact of having seismic data in the classroom on the following (1-10=Highest)

	1	2	3	4	5	6	7	8	9	10	N/A
on your subject knowledge	○	○	○	○	○	○	○	○	○	○	○
on your students' learning	○	○	○	○	○	○	○	○	○	○	○
on the quality of your curriculum	○	○	○	○	○	○	○	○	○	○	○

Software/Website

* 6. I would recommend to another teacher that it is worthwhile having students learn to

	Yes	No	Never tried	N/A
recognize earthquakes in streaming jAmaSeis data	○	○	○	○
use jAmaSeis to look at an earthquake	○	○	○	○
upload and share data through the SIS website	○	○	○	○

Program Priorities

* 7. Would you be interested in additional instruction about any of the following topics (check all that apply)

- [ ] Seismometer hardware
- [ ] Using jAmaSeis
- [ ] Information about earthquakes I record
- [ ] How to determine if a recording is an earthquake
- [ ] How to locate the epicenter of a recorded earthquake
- [ ] How to calculate the magnitude of a recorded earthquake
- [ ] Advanced data analysis
- [ ] Other (please describe)

* 8. Are there any specific resources that would help you increase impact in your classroom?

* 9. Any questions or suggestions for the Seismographs in Schools program?

* 10. Would you and your students be interested in participating in a seismology based contest with international schools (France, UK, Switzerland)? The contest would involve a little bit of internet research and a hands-on project every two months for students to learn more about the InSight Mission to Mars. Check out the Namazu contest!!

- ( ) Yes
- ( ) Maybe
- ( ) No

* 11. Please let us know if you have equipment to return, need new electronics, we removed your station from the database by mistake, or have another major issue you would like us to email you about.

- ( ) Not at this time
- ( ) Please contact me about...

Thank you! If you have any questions or problems throughout this school year, contact us at sishelp@iris.edu.