



## **Geographic Information System Incorporated into Earth Science Classrooms to Enhance Individual Learning Development with Interconnected Concepts**

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Geographic Information System, GIS, is a powerful tool and when incorporated into Earth Science classrooms, can enhance and empower students' engagement in their learning. Through utilization of GIS, students can process what they are learning in a spatially orientated method, which allows them to make connections among different related concepts. For example, if students are given a map in a GIS software with multiple layers of data on earthquakes, plate tectonics, and volcanoes then they can manipulate this information to come up with their own patterns. Through allowing students to develop their spatial recognition of where the Earth's plate boundaries are and where earthquakes have occurred, students can see how these two concepts are connected.

In a guided but exploratory activity, students would be given multiple different websites that they could explore to research what different type of plates there are while they are working simultaneously with the GIS software. Using a plate tectonics layer, including data on type of boundary, students can explore and estimate which direction the plates are moving. When they look up convergent boundaries and see that the oceanic plates submerge under continental plates they can see where volcanic chains might be. Once they understand this in a spatial way, students can predict where they think volcanoes could be, based on where convergent boundaries are. When they manipulate the volcanic layer and see abnormalities to what they just learned, it will cause them to have cognitive dissonance, which will force them into seeking further understanding. The concept of a hot spot can then be introduced to resolve the cognitive dissonance and emphasize the idea that plates we live on are moving.

Concepts can further be developed through GIS by showing how the strength and frequency of earthquakes are related to the level of activity at the plate boundary. This can be done by manipulating the map layer that represents earthquakes so that students can visualize each earthquake based on depth, size, or just location. If it is more active, then students should predict which direction it is moving based on the different boundary types. Rather than a traditional lecture approach, GIS software enables students to explore and manipulate relevant variables in an interactive and stimulating environment. It can harness their sense of wonder and exploration by giving them the opportunity to be hands on with the technology.

In addition, using GIS in an Earth Science classroom can foster empathy in students. When the students look at the dots on the map, the hope is that they can visualize what type of destruction that could happen, especially when they change the variable function based on location to magnitude. As a teacher in Virginia, U.S.A., most students here have not experienced an earthquake. Although their perspective is limited, by allowing them to explore different locations with GIS, they create connections with places where earthquakes occur. The data and information they use allows them to learn about how the earth's systems are not isolated events but are the reality people live in.