STUDY OF THE MENTAL MODEL OF VOLCANO IN PRIMARY SCHOOL STUDENTS, THROUGH THE ANALYSIS OF DRAWINGS

Volcanic activity is a factor for landscape building, and causes a great impact on human beings and the natural environment. For this reason, the study of volcanoes is very important in hazard and risk assessment, as well as in mitigation planning. The aim of this paper is to study the image of a volcano that a group of Centroamerican primary school children have, in a place with high volcanic activity. This study carried on with a sample formed by 100 students with ages between 7 and 9 years old, plus 162 with ages between 10 and 15 years old, who drew a volcano. The drawings were analyzed according to the deductive categories: volcano shape, internal structure, human presence and disaster. The results indicate that the mental model of volcanoes of students is more influenced by what they see in the audiovisual media and other sources, than by their own experience with the volcanoes in the region where they live.

Keywords: Volcanoes, Mental model, Science learning

INTRODUCTION

Oppenheimer (2011) states that "The largest volcanic eruptions tend to occur at volcanoes we know nothing about", therefore, particularly for people living in areas of potential volcanic impact, the study and monitoring of volcanoes is key in hazard and risk assessment, as well as in the planning of mitigation plans.

Children are capable of elaborating mental models to try to explain natural phenomena, based on previous ideas that they construct through interaction with the environment, with primary sources such as school, the media, analogical thinking, etc (Blake, 2014). Although it is not easy to know students' knowledge in depth, especially due to the limitations of assessment tools (Vilchez y Perales, 2002), research in Earth Science education highlights the importance of knowing students' previous ideas, in order to promote conceptual changes that help them develop an understanding of their natural environment, as well as to prepare them for future events (Orion, 2019).

The objective of this work is to know the students' previous ideas about volcanoes, understood as manifestations of their mental models, in a sample of primary school students from three schools in Nicaragua, located in volcanic risk areas. The intention is that the results become a starting point to develop didactic strategies to improve students' knowledge of their environment, as well as of volcano hazards and risks, in order to favor the effective implementation of mitigation plans.

METHOD

A descriptive research was carried out, through the analysis of the drawings of volcanoes made by school students participating in the PREVIA project (Preparedness and Resistance to Eruptions of Ibero-American Volcanoes), an interdisciplinary project that focus in volcanoes, from geological, geophysical, economic, social and educational points of views.

Sample

The sample is made up of 262 students (38.2% from 7 to 9 years old and 61.8% from 10 to 15 years old), from three schools located in the area of Managua, around the Apoyeque lagoon, chosen by convenience. This volcano, which does not have the typical stratovolcano profile, shows its last explosive type eruption 2000 years ago. It is considered by experts from the University of Manchester (2015) as one of the ten volcanoes that

represent the greatest danger to humanity, with real probabilities of erupting in the next 100 years. Specifically, the Héroes y Mártires de Xiloá school is 4.2 km away, the Presbítero Bruno Martínez school is 18.6 km away, both in a semi-rural area, and the Roberto Clemente school is 8.6 km away in Ciudad Sandino, an urban area.

Instruments

For the study a questionnaire was applied, in which the students were asked to draw a volcano freely.

Data analysis

The analysis of the drawings was performed with the Nvivo V.11 software, for the two student groups differentiated by age, following a deductive process according to the categories proposed by Perales et. al. (2021) and García-Yeguas et. al. (2022): volcano shape, internal structure, volcano association, volcano color, crater, volcanic products, lava color, eruptive processes, context (geological, presence of living beings, presence of human beings, disaster). For the purposes of this paper, only the categories volcano shape, internal structure, presence of humans, and disaster are described.

RESULTS AND DISCUSSION

The table 1 summarizes the results in the volcano shape category.

Tabla 1. Volcano shape category - results.

Volcano shape	**7 to 9 years old (n=100)**	**10 to 15 years old (n=162)**
Cylinder	8.00%	9.3%
Cylinder-Triangle Hybrid	31.00%	31.5%
Elongated acute isosceles	**45.0%**	**43.2%**
Obtuse angled isosceles	9.0%	14.2%
Other	7.0%	1.8%

Children in both age groups most frequently drew the volcano as an elongated acute isosceles triangle (Fig 1a), and in second place they drew it as a cylinder-triangle hybrid (Fig 1b). Only 9.0% of the first group, and 14.2% of the second, drew the volcano as an obtuse-angled isosceles shape (Fig 1c), although this is the most common volcano shape in the area. None of the participants drew a volcano with similarities in the shape to the Apoyeque volcano. In this regard, in the collection of previous ideas, Kirby (2022) found that volcanoes are usually considered as a high peak with a crater at the top. He considers that this fact may be influenced by the spectacular photographs of volcanoes disseminated by the media, usually in subduction processes, which usually have this shape. Thus, a possible explanation for the findings may be that the mental model of volcanoes constructed by the students is mainly influenced by the images they see in the media, rather than by observation of their natural environment. Similar findings are observed in other areas with active volcanoes by García-Yeguas et al 2022.

In the internal structure category, only 2.0% of the students aged 7 to 9 years, and 4.9% of the students aged 10 to 15 years, drew it (Fig 1a). None of the students in the first group drew the magma chamber, which was drawn by 3.1% of the students in the second group. These results agree with Dal (2006) and García-Yeguas et al

(2022), in that most of the students do not draw the internal structure. Although in both studies, the percentage of elementary school students who drew the internal structure of the volcano was appreciably higher, reaching 36.0% in the older study.

Figure 1. Examples of volcano drawings: a) Elongated acute isosceles shape; b) Cylinder-Triangle Hybrid shape; c) Obtuse angled isosceles shape.

With respect to the presence of the human beings category, it is striking that about 96% of the students in both groups did not include them in the drawing, despite the fact that they themselves live in a volcanic area. And in direct relation to this finding, in the disaster category, only 4.0% in both groups illustrated calamity situations, which suggests that these students are not aware of the threats and risks of the area they live in.

CONCLUSIONS

The mental model of volcanoes that the students participating in this study have, is more influenced by what they see in media images, than by their natural environment. Therefore, it is important to implement pedagogical strategies that strengthen their ability to observe the environment and help them recognize the threats and risks of volcanoes, in order to promote their informed participation in disaster mitigation plans developed by the public administration.

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