Alternative Conceptions Concerning the Earth's Interior Exhibited by Honduran Students

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ABSTRACT

Although multiple studies of misconceptions in Earth science have been completed using samples of North American and European students and teachers, little research has been conducted on alternative Earth science conceptions in developing countries. The current study was conducted in 5th- and 6th-grade classrooms in eastern Honduras, Central America. The goal of the study was to gather data documenting Honduran students' conceptions of the Earth's interior. This qualitative study used participant-generated drawings and interviews to access students' conceptions of the Earth's interior. Results suggest that Honduran students, ages 9–14 y, express varying levels of understanding regarding this science concept. Many exhibit alternative conceptions, including nonconcentric layers in the Earth; the presence of physical objects, such as houses, inside the Earth; and the existence of mythical creatures within the Earth. This study provides data relevant to geoscience education in Honduras, has implications for geoscience education in tectonically active regions where Earth science is not a major part of the curriculum, and offers suggestions for teaching abstract Earth science concepts to concrete learners. The study also provides information for educators that teach students who are recent immigrants from Honduras and for those who teach students of limited language and/or reading proficiency. © *2013 National Association of Geoscience Teachers*. [DOI: 10.5408/12-317.1]

Key words: Earth's interior, alternative conceptions, English language learners

INTRODUCTION

A considerable amount of research has been conducted in North America and Europe concerning student conceptions of the sciences, as evidenced by the bibliography of student alternative frameworks compiled by Pfundt and Duit (2000). Notable works in physics, chemistry, and biology include Brown (1989), Clement et al. (1987), Gabel (1989), and Bishop and Anderson (1990). Until recently, few studies had been carried out concerning student comprehension of Earth science concepts. Dove (1998) wrote an early review on alternative conceptions in Earth science, including conceptions about rocks, earthquakes, volcanoes, the Earth's structure, weathering erosion, and soil and found alternative conceptions widespread in those areas. Since then, researchers in the emerging field of geoscience education have continued to investigate student and teacher conceptions on a variety of Earth science concepts, from understanding about time to students' representations of the water cycle (e.g., Trend, 1998; Gobert and Clement, 1999; Ramos et al., 2001; Roldão et al., 2001; Dodick and Orion, 2003; Bach and Franch, 2004; Blake, 2005; Figueiredo and Marques, 2005; Libarkin et al., 2005; Onida and Segalini, 2006; Marquez and Bach, 2007). These studies are important because having a better understanding of the alternative conceptions learners hold about Earth science phenomena will improve instruction in the geosciences.

One particular area of interest in geoscience education has been student conceptions of the structure of the Earth's interior. Understanding the structure of the Earth's interior may be a prerequisite for understanding bigger ideas in Earth science, such as plate movement and the causes of earthquakes and volcanoes (Gobert, 2005). Thus, understanding how students think about the Earth's interior may support instruction in Earth science and the eventual understanding of important, big ideas. During the past two decades, multiple studies have investigated student conceptions of the Earth's interior using a variety of methods, from paper-and-pencil tests to student drawings, and interviews, to assess students' conceptions (e.g., Lillo, 1994; Sharp et al., 1995; DeLaughter et al., 1998; Gobert and Clement, 1999; Nottis and Ketter, 1999; King, 2000; Libarkin et al., 2002, 2005; Beilfuss, 2004; Blake, 2005; Dahl et al., 2005; Dal, 2007). Most of these studies focused on university-aged students or in-service teachers' conceptions of the Earth's interior (e.g., DeLaughter et al., 1998; Libarkin et al., 2002; Beilfuss, 2004; Dahl et al., 2005; King, 2005; Libarkin et al., 2005). Four of these studies used a paper-and-pencil test (DeLaughter et al., 1998; Libarkin et al., 2002; Dahl et al., 2005; King, 2005), one used a paper-and-pencil test in combination with interviews (Libarkin et al., 2005), and the final study used drawings and interviews (Beilfuss, 2004) to investigate student conceptions of the Earth's interior. These studies have shown that, although most university students and in-service teachers have a basic understanding about the structure of the Earth's interior (i.e., the Earth is a concentrically layered planet), many still hold alternative conceptions as to its physical makeup (solid versus liquid).

Only a few studies have investigated younger students' conceptions of the Earth's interior (e.g., Lillo, 1994; Sharp et al., 1995; Gobert and Clement, 1999; Dal, 2007). Gobert and

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TABLE I: List of Earth science–like activities in Honduran Primary Curriculum by grade level.

Grade	Subject	Topic
2	Natural sciences	Comprehend that the Earth is a body in space. Understand the difference between Earth, water, and air. Establish a size comparison between the Earth, moon, and sun.
3	Social studies	Become familiar with Honduran geography. Explain the formation of mountains, valleys, and rivers. Explain the importance of different forms of relief (i.e., mountains, valleys, etc.). Recognize the characteristics of natural regions (relief, climate, vegetation, etc.).
4	Natural sciences	Understand the composition of planet Earth. Narrate the origin and consequences that affect the Earth's surface. Explain security measures for natural disasters.
4	Social studies	Demonstrate the ability to use maps and globes. Locate Honduras, nearby countries, oceans, and other natural regions (mountains, rivers, etc.).
5	Natural sciences	Understand the importance of planet Earth. Differentiate the layers that make up the Earth (biosphere, atmosphere, lithosphere, and the hydrosphere). Explain the origin and importance of rocks. Explain natural phenomena that act to modify the surface of the Earth.
6	Social studies	Understand universal geography. Explain that planet Earth formed as part of the solar system. Discuss climate and how it relates to human activities on the continents. Describe the importance of scientific and technological advances and how they better living conditions on the Earth.

Clement (1999) did so as part of a larger study that compared U.S. 5th-grade students' conceptual understanding of plate tectonics after reading a text, after reading a text and drawing a diagram, or after reading a text and producing a written summary. Although some of the students in their study drew diagrams of the Earth's interior, their study did not specifically investigate student alternative conceptions of the structure of the Earth. Lillo (1994) studied Spanish primary students' (ages 10–15 y) conceptions of the Earth's interior using drawings and uncovered numerous alternative conceptions relating to the structure of the interior. For example, it was common for those students to believe that the Earth's core was molten and the center of the Earth acted as the source for volcanic magma. Exaggerated thickness of the Earth's concentric layers dominated students' drawings. It was also common for the older children, who were asked to include the asthenosphere in their drawings, to incorrectly position the spherical layers, usually by placing the asthenosphere above the mantle and not within the mantle. Sharp et al. (1995) asked 9–10-y-old children in the UK, "What is inside the Earth?" They received a variety of responses, including bricks, skeletons, pipes, and old stuff. After the question was modified, most of the students in the study described the interior of the Earth as solid, uniform, and dark. Some students thought it was warmer inside the Earth, and some thought it was colder. A recent study by Dal (2007) looked at 120 Turkish students' (ages 13–14 y) ideas about the structure and process of crystals, volcanoes, rocks, and the Earth. The findings from that investigation generally agreed with those of Lillo (1994). Most Turkish students thought the Earth was composed of three layers: the crust, the core, and an in-between zone; the Earth was filled with either water or magma; and the core served as the source of magma.

Although there is a growing body of research related to alternative conceptions in the geosciences, especially at the university level, there is a need for more research at the K–12 level (Lewis and Baker, 2010). Furthermore, given that most alternative-conception research in Earth science has been conducted in North America and Europe, comparatively little is known concerning students' conceptions of Earth science phenomena outside these areas. This raises issues of equity in research (e.g., Which populations are being left out?) as well as questions such as whether students from other areas of the world exhibit the same alternative conceptions, or do they differ? The research presented in this article investigates upper-elementary, Honduran students' conceptions of the structure of the Earth's interior. Honduras is an interesting place to conduct this study because it is located in a geologically active region of the world, where most of the population directly experiences tectonic activity; yet, geoscience education is not a major focal point in the national curriculum (see Table I for a list of Earth science concepts covered in the primary grades). A better understanding of the range of Honduran students' conceptions of Earth science phenomena may help to start a conversation of how to support the teaching and learning of Earth science in Honduras. Moreover, Honduran students' conceptions of the Earth's interior may inform educational efforts and research studies in other countries where Earth science education is not a focus, but tectonic activity is common. Finally, we believe it is important to be aware of alternative conceptions held by Honduran students because there is a high rate of immigration from Honduras to the U.S. and Canada. Understanding Honduran students' prior conceptions and potential reasons for those conceptions may support instructional practices in schools serving students from Honduras and, perhaps, from other countries in Central America.

THEORETICAL BACKGROUND

Often, students construct and/or assimilate new knowledge inaccurately. A number of terms have been used to describe the inaccurate construction or assimilation of knowledge, including naïve beliefs, misconceptions, or alternative conceptions (Ault, 1984; Pfundt and Duit, 1994; Wandersee et al., 1994). For example, the term *misconception* has been used in studies where students have been exposed to some formal model of a science concept but have assimilated the model incorrectly (Clement et al., 1987). *Alternative frameworks* (Driver and Easley, 1978), *alternative ideas* (Engel and Driver, 1981), and *alternative conceptions* (Hewson, 1981) are used when existing student knowledge does not conform to scientific knowledge (Abimbola, 1988). It has been argued that the term *alternative conception* is

preferable when describing student conceptions in science because it is more inclusive than other terms (Abimbola, 1988). Alternative conceptions are hypothesized to arise from everyday experiences, perceptions, cultural influences, and language (Hawkins and Pea, 1987; Solomon, 1987; Strike and Posner, 1992). These conceptions are deeply embedded in our consciousness and are thus thought extremely resistant to elimination or change (Hewson, 1985; Brown, 1992; Wandersee et al., 1994). The durability of alternative conceptions has been noted across diverse contexts, from school age children in Portugal and Spain (Lillo, 1994; Marques and Thompson, 1997a, 1997b) to university students in the U.S. (Perkins and Unger, 1999). This suggests that alternative conceptions likely become deeply rooted within the minds of students. The study of alternative conceptions is critically important because a better understanding of the source and nature of those naïve beliefs, and how students incorrectly construct and assimilate information, will assist educators in designing learning experiences that support students in revising alternative conceptions in favor of more scientifically accurate conceptions (Bransford et al., 1999). With the growing interest in developing instructional strategies to facilitate conceptual change, there is increased attention on student conceptions of the phenomena presented to them in Earth science classrooms.

CONTEXT

Honduras is a predominantly Spanish-speaking country located in Central America between Guatemala, Nicaragua, and El Salvador. Its population is slightly more than 8 million inhabitants; most (90%) of whom are of mixed European and Native-Honduran descent. In 2010, 65% of the Honduran population lived below the poverty line (Instituto Nacional de Estadísticas de Honduras [INEH], 2010). The Honduran education system is administered by the Honduran Secretary of Education. The Secretary of Education defines national curriculum standards for preschool, primary, secondary, and university education. The Secretary of Education provides schools with supplies and guidance for the teaching of four core academic areas: math, science, social studies, and Spanish. All public schools receive a national curriculum guide dictating what topics should be taught throughout the 200-d school year (Secetaría de Educación de la República de Honduras, 2003). Because of frequent teacher strikes, and poor communication between the government, teachers, and communities, the 200-d school year is effectively reduced to approximately 125 d (Arcia and Gargiulo, 2010). This is especially true in rural regions where teachers and students must travel on poor roads or walk trails to reach school; these may be impassible during certain parts of the year. Because of the shortened school year, it is difficult for teachers to cover the proposed curriculum in its entirety (Carnoy, 2002). Teachers must either rush through the curriculum or cut topics they feel are unimportant. Furthermore, few geoscience courses are offered at Honduran universities, meaning that most teachers trained in Honduras have little formal training in Earth science and may feel uncomfortable teaching these topics. For example, the National University offers only a few basic geology courses through the Department of Space Sciences, Civil Engineering (Universidad Nacional Autónoma de Honduras, 2012), and the newly formed Earth Sciences Institute (Instituto Hondureño de Ciencias de la Tierra [IHCIT], 2012). In the future the IHCIT intends to offer more courses (M. Rodriguez, pers. comm., August 23, 2012). There are currently no geoscience courses at teacher preparatory or normal schools, where most teachers receive their education. Because Earth science represents only a small part of the national curriculum (see Table I) and few teachers have training in the geosciences, these topics are likely often cut from the curriculum, resulting in students with minimal formal exposure to Earth science education.

METHOD AND DATA SOURCES

Our research dealt with student conceptions of the Earth's interior. Specifically, we asked, "What are Honduran students' conceptions of the Earth's interior?" Alternative-conceptions research commonly makes use of one of two types of analysis frameworks: nomothetic and idiographic. Nomothetic studies consider the congruence of student understanding with scientific thought. Paper-and-pencil tests are commonly used in these types of studies (Treagust, 1988). Idiographic studies, on the other hand, probe student understanding of natural objects to raise awareness of possible perspectives that students may bring to the classroom. Such studies use interviewing and other tasks, such as drawings, to determine students' conceptions (Wandersee, et al., 1994). We used an idiographic framework consisting of participant-generated drawings and interviews to access students' conceptions of the Earth's interior. We chose this framework for several reasons: first, because past research has documented that drawings can be a powerful heuristic in learning about what people think (Gobert and Clement, 1999); second, most students enjoy drawing (Hayes et al., 1994), thus the activity would likely not be viewed as an assessment and students would not be intimidated or afraid to give the wrong answer (White and Gunstone, 1992); and finally, we felt the combination of drawings and interviews would provide a clearer picture of these students' conceptions than would a traditional paper-and-pencil test.

Participants

This study was conducted in four classrooms at three primary schools in eastern Honduras. Two of the schools were public (Pedro Molina [PM], two classes; and Placido Nuñez [PN], one class), and the third (Escuela Privada Noroeste [NO], one class) was private.[1] The first author (D.K.C.) selected the schools based on his familiarity with the teachers and the teachers' interest in participating in the study. At the time of the study, the typical family income of students attending public schools was approximately US$116/mo (Banco Central de Honduras, 2003). Family incomes at the private school were substantially higher. A total of 105 students participated in the initial study, and 38 of these students (37%) participated in the subsequent interviews. Interviewees ranged in age from 9 to 14 y, and most of the students were at a 5th-grade level. Interviewees were 39% female ($n = 15$), 61% male ($n = 23$), with most attending a public school ($n = 84$; 80%). See Table II for demographic data.

[1] All names of schools and individuals are pseudonyms.

TABLE II: Student demographic data by percentage of participants ($N = 105$).

Gender, No. (%)		Grade Level, No. (%)	
Male	Female	5th	6th
59 (56)	46 (44)	66 (63)	39 (37)

Data Collection

We began by asking students to draw a picture of the Earth's interior. The task of drawing the interior of the Earth was introduced by standing before the class and slicing a watermelon in half. Students were asked to draw what they would observe inside the Earth if it were sliced into two equal parts. Participants were given 20 min to draw and label what they thought they would see. A native Spanish speaker (the teacher) was present in each class and ensured that students understood the task.

On completion, all 105 drawings were categorized into one of five levels of conceptual understanding (1–5) based on the presence or absence of various features, structures, or processes represented in the students' drawings. Level 1 was the least sophisticated, and Level 5 was the most sophisticated. Students' drawings categorized as Level 1 displayed major alternative conceptions, such as surface features or mythical creatures inside the Earth; Level 2 displayed either rudimentary, concentric layers or included appropriate materials like lava and rock inside the Earth; Level 3 displayed concentric layers or included zones like the core, mantle, and crust; Level 4 displayed concentric layers and included materials like lava and rock, and included zones like the core, mantle, and crust, or demonstrated that the Earth's interior was not static (i.e., there are processes occurring inside the Earth); and Level 5 displayed a scientifically accurate structure for the Earth's interior and also demonstrated an understanding that the Earth's interior was not static. Each drawing was categorized separately by two researchers (D.K.C. and M.M.). When there was a discrepancy between the researchers' categorization, the issue was discussed until consensus was reached. As we categorized the drawings into the five levels, we noticed that eight features were widespread in many student drawings (e.g., the presence of water or surface features inside the Earth). These frequent objects or themes were noted and are discussed in the "Results" section.

We then conducted a semistructured interview with 7–11 students from each class ($n = 38$). Interviewees were selected based on their drawings. At least one drawing from each of the five levels represented in each of the classrooms was selected using the following criteria: (1) if drawings in a particular class had similar features at a given Level (e.g., all Level 1 drawings showed surficial objects), one drawing was selected at random from that Level; and (2) if drawings had distinct features at a given Level (e.g., Level 3 drawings included both concentric and nonconcentric layers), one drawing was selected at random from each group at that Level. Interviews helped us to better understand features in the students' drawings and where the students' ideas may have originated. We asked several questions of each interviewee (see Appendix 1 for interview questions). For the sake of consistency, all 38 student interviews were conducted by a single person (D.K.C., who is fluent in Spanish). Interviews lasted approximately 10 min. Student responses were recorded by hand. The interviewer used member-checking to confirm that handwritten notes matched student responses. Interview transcripts were translated to English and transcribed to computer. The interview data were then compared with the original tentative categorization of student drawings to check the validity of the classification and indexing systems. Although we cannot ensure that these Levels truly represented all students in the study, by operationally defining each Level and by analyzing both the interview and the drawing together, we hoped to achieve an overall measure of content validity. Construct validity was achieved by the consistency observed between a given student's interview and his or her drawing. Use of the drawing task, in combination with the interview, allowed for further examination, or confirmation, of students' mental processes (see Appendix 1 for a sample interview).

RESULTS

Student Drawings

Results suggest a range of understanding among 5th- and 6th-grade, Honduran students regarding the interior of the Earth (see Table III). The range included nonscientific conceptions of the Earth's interior, at one end of the spectrum, to understandings that were not only scientifically correct but also included some conceptual understanding of processes occurring in the Earth's interior, at the other end of the spectrum. Representative student drawings for each of the five Levels are provided in Figs. 1(a)–1(e). Half of the students ($n = 53$) exhibited a Level 1 understanding. These students either struggled with the concept of drawing the interior of the Earth and/or placed objects such as animals, houses, or mythical creatures inside the Earth. The remaining students ($n = 52$) were classified as Levels 2–5. These students displayed a rudimentary to more complex understanding of the Earth's interior. Only 20% ($n = 21$) of students were in Level 4 or Level 5. There were no major differences between students from public and private schools.

The most frequent objects drawn by students were surface features, such as animals, trees, houses, etc. (see Table IV). These objects appeared in 41% ($n = 43$) of students' drawings. Other common features included water inside the Earth ($n = 38$; 36%), concentric layers ($n = 38$, 36%), and physical and chemical features, such as the core and/or mantle, or other features like lava or magma ($n = 19$, 18%). Only two students indicated that dynamic movement or changes, either of chemistry, physical state, or density, occur within the Earth. This was demonstrated with lines or written words in the students' drawings. Most students viewed the Earth as a static body made up of one or several related materials, such as dirt, soil, water, or rock. An unexpected object that appeared in one student's drawing was a giant horseshoe magnet.

Student Interviews

Most ($n = 30$, 79%) of the students who were interviewed reported having been introduced to the topic of the Earth's interior previously in school. This is consistent with what we would expect, given the Honduran Primary Curriculum includes some Earth science topics from grades 2–6 (see Table I). Slightly over half of the students interviewed ($n = 20$) reported having watched a program

TABLE III: Characteristics of student drawings with number of students in each category.

Level	Characteristics	Students in Level ($N = 105$), No. (%)	Students Interviewed From Each Level ($N = 39$), No. (%)
1	At least one of the following: (a) had difficulty grasping the concept of the center of the Earth and scattered objects throughout the drawing that had little or nothing to do with the interior of the Earth, or (b) displayed mythical creatures and fantastic scenes at the interior of the Earth	53 (50)	15 (39)
2	Had either: (a) rudimentary or nonconcentric layering, or (b) Earth materials such as lava and rock or ideas like magnetism and heat	20 (19)	8 (21)
3	Showed either: (a) concentric layering, or (b) rudimentary or nonconcentric layering with Earth materials, such as lava and rock; ideas like magnetism and heat; or appropriately labeled zones (crust, mantle, and core)	12 (11)	4 (11)
4	Showed either: (a) concentric layering with Earth materials, such as lava and rock; ideas like magnetism and heat; or appropriately labeled zones (crust, mantle, and core), or (b) nonconcentric layering and conveyed the idea that the Earth's interior is not static	19 (18)	10 (26)
5	Showed: (a) concentric layering and conveyed the idea that the Earth's interior is not static	1 (1)	1 (3)

on television about the interior of the Earth. Sixteen of these students specifically mentioned the Discovery Channel in the interview. Only six of the students who reported learning about the Earth's interior on television had drawings that were categorized as Levels 3–5. The remaining 14 drawings were categorized as Levels 1 ($n = 9$) and 2 ($n = 5$). In describing the features in their drawings and why they drew them, the 15 students interviewed from Level 1 (39%) discussed the existence of people, mythical creatures, or extinct organisms, such as dinosaurs in the Earth. Five of these students shared that their ideas came from watching a program on television. For example, Deci said, "At the center of the Earth, there are prehistoric animals like pterodactyls and fish. I learned from the Discovery Channel that a meteorite hit the Earth a long time ago, killing and burying the dinosaurs and other animals. I think they came back to life under the Earth and live there now." Frander mentioned learning on television that there is a "giant anaconda at the center of the Earth that sustains the Earth" [see Fig. 1(c)]. School, books, and parents were other sources from which students obtained information about the Earth's interior, although four students reported never having learned about it before. The eight students interviewed from Level 2 (21%) expressed more sophisticated ideas describing features or phenomena that belong inside the Earth, such as lava and magnetism. For example, Angela, a 6th grader said, "I think there is a magnet inside the Earth that keeps things in place so air, water, and rock don't float away." She added, "I think I learned this on Discovery." Two other students also mentioned magnetism in their interviews, and one of these students included a bar magnet in his drawing. The 15 students interviewed from Levels 3–5 (39%) expressed more advanced conceptions about the Earth's interior in their interviews. For instance, a 5th grader, Marco, whose drawing was categorized at Level 4 described "layers and divisions between lava and rock inside the Earth … sometimes the lava escapes onto Earth's surface." Marco reported discussing the Earth's interior with his father after watching a television program. Marco said, "After watching the show, I talked with my dad about it, and he explained a lot of it." Other interesting themes brought up during student interviews included the belief that there was a connection between the interior of the Earth and atmospheric features and processes (such as the hole in the ozone layer and the greenhouse effect) and the view that God created everything both on and inside the Earth.

DISCUSSION

Drawing and interview data revealed information about both the range in levels of understanding (Table III) and common alternative conceptions (Table IV) held by 5th- and 6th-grade, Honduran students about the Earth's interior. Analysis of student drawings indicated that, although there was a range in understanding from Level 1 to Level 5, most students held fairly naïve conceptions about the Earth's interior ($n = 77$; 73% of students were at either Level 1 or Level 2). This is not surprising given the small amount of time devoted to Earth science concepts in the Honduran curriculum.

Some of the common alternative conceptions we observed in Honduran 5th and 6th graders' drawings and heard about in interviews were similar to previous studies conducted in other countries. For example, Honduran students often included features such as water, lava, and magma in the Earth's interior (Lillo, 1994; Dal, 2007), and many drew concentric layers (DeLaughter et al., 1998; Libarkin et al., 2002; Dahl et al., 2005; King, 2005). However, we also observed a number of alternative conceptions in this study that had not been reported in previous studies of the Earth's interior in North America and Europe, such as the presence of surface features (like trees or houses), people, and mythical creatures. These features appeared in nearly half of the student drawings. This finding warrants further investigation. Furthermore, because it is believed that having an adequate understanding of Earth's internal structure may be a prerequisite for understanding bigger ideas in Earth science (Gobert, 2005), students with alternative conceptions like those reported in this study might have difficulty constructing mental models for bigger ideas, such as plate movement and the causes of earthquakes and volcanoes. An important question to consider is where these alternative

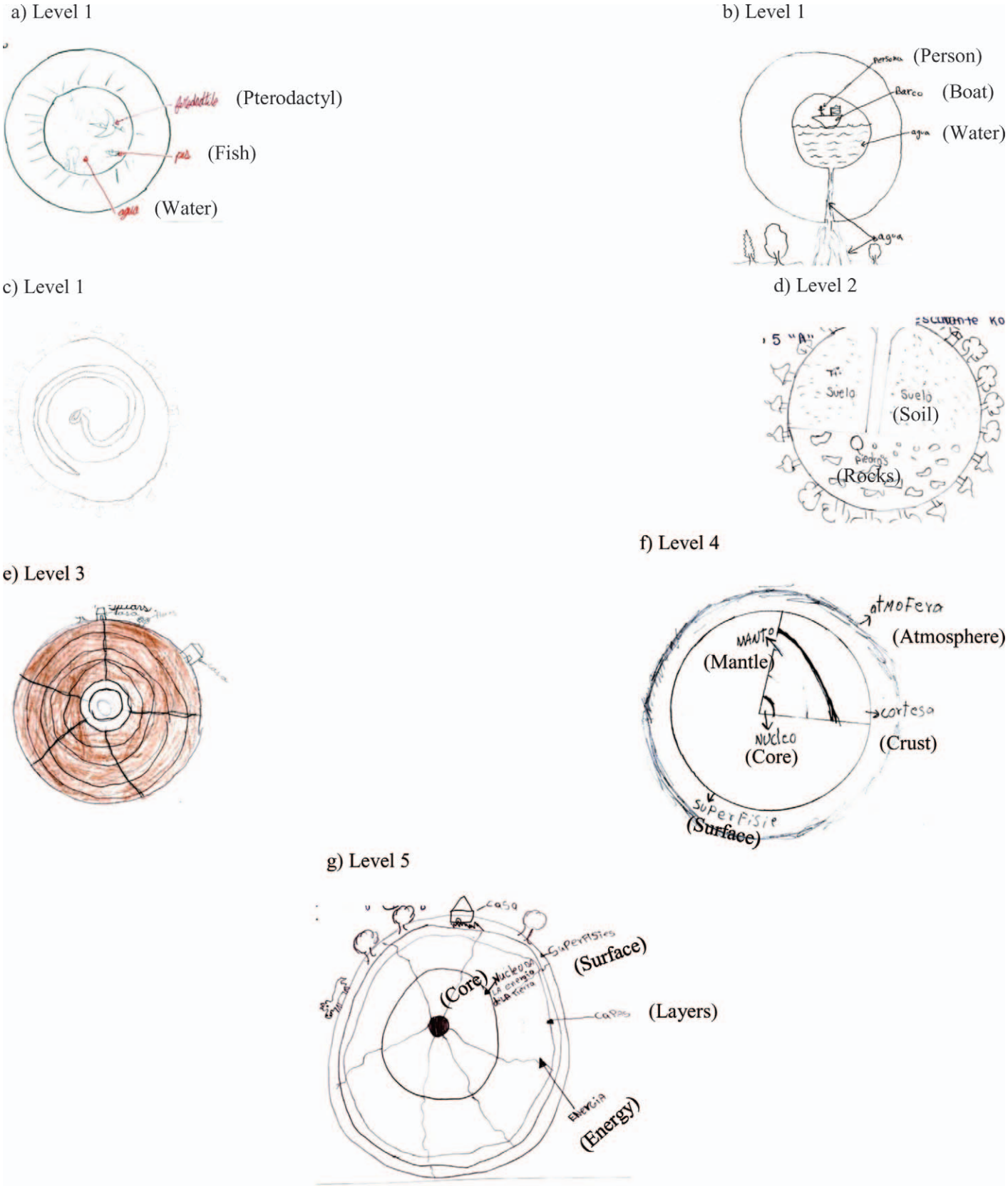

FIGURE 1: Examples of student drawings from each of the five Levels. (a)–(c) Level 1. (d) Level 2. (e) Level 3. (f) Level 4. (g) Level 5.

TABLE 4: Frequent object or themes displayed in student drawings.

School[1]	With Water, No. (%)	With Myths, No. (%)	With Concentric Layers, No. (%)	With Physical or Chemical Features, No. (%)	With People	With Volcanoes, No. (%)	With Lava, Magma, or Heat, No. (%)	With Surface Features, No. (%)
1-PM	7 (18)	4 (57)	16 (43)	5 (26)	2 (18)	0 (0)	1 (8)	17 (40)
2-PM	6 (16)	3 (43)	2 (5)	1 (5)	0 (0)	2 (33)	2 (15)	4 (9)
3-PN	12 (32)	0 (0)	10 (26)	7 (37)	9 (82)	0 (0)	0 (0)	17 (40)
4-NO	13 (34)	0 (0)	10 (26)	6 (32)	0 (0)	4 (67)	10 (77)	5 (11)
Total	38	7	38	19	11	6	13	43

[1]Abbreviations: PM = Pedro Molina public school; PN = Placido Nuñez public school; NO = Escuela Privada Noroeste private school. All school names are pseudonyms.

conceptions originate. Are they coming from instruction or from other sources?

As we interviewed students, one potential explanation for these anomalously placed features arose. More than half of students (20/39) interviewed reported having watched a program on television about the interior of the Earth. Only six of those 20 students' drawings (30%) fell into the higher levels (Levels 3–5). We know from previous research that television and other media have the potential to affect students' understanding of scientific phenomena (Schoon, 1992). The presence of surface features, people, and mythological creatures inside the Earth in many student drawings may have come from these programs. Sixteen of the 20 students (80%) who reported learning about the Earth's interior on television mentioned learning about it on the Discovery Channel. Assuming the scientific information on the programs they viewed was correct, what might account for the anonymously placed features? In Honduras (and much of Latin America), television programs like Animal Planet and the Discovery Channel (where most of the students reported watching a program on this concept) are dubbed in Spanish from English; however, interviews with experts in these programs are normally not dubbed, but instead occur in English with Spanish subtitles. The Honduran literacy rate is approximately 85% (Banco Central de Honduras, 2002; INEH, 2010). This statistic does not consider those who can read but are emerging readers like children (and in some cases, adults). Emerging readers may have difficulty reading quickly and/or fluently enough to fully comprehend information presented in subtitles, making partial comprehension of these programs the norm. Because many science-based television programs often present important information through interviews with experts, emerging readers in Honduras, and potentially in other places where programs are partially dubbed, may only be getting part of the story and are left to fill in the remaining details with their own conceptions. This may result in alternative conceptions. Another explanation beyond language acquisition or literacy ability as a potential source for the alternative conceptions observed in this study might be that some of these students were simply confusing fictional accounts of what is inside the Earth (from television, books, etc.) with scientific accounts. Because alternative conceptions often become deeply rooted in students' minds (Wandersee et al., 1994), if these conceptions are not addressed by the curriculum or through discussion with someone who is more knowledgeable about the subject (as was the case for the boy who discussed the concept with his father), then they will likely persist. Although we cannot be certain of the origin of the alternative conceptions described in this study, results suggest that a potential area for future research on alternative conceptions might involve investigating how students' language or reading ability affect their understanding of information delivered through a particular media source (e.g., subtitles in television).

A limitation of this study is that students may have left out certain features simply because they did not feel they had the skill to draw them accurately. This could affect the Level at which students' drawings were categorized. As students were introduced to the drawing task they were told they could either draw features or simply write the name of the features in their drawing. Moreover, during the interview process students were asked whether there were additional features they did not include in their drawings that they would have liked to include. These actions helped to minimize the fact that some students might have felt self-conscious of their drawing ability.

IMPLICATIONS FOR RESEARCH AND INSTRUCTION

Results from this study contribute to the overall body of knowledge on younger students' alternative conceptions in the geosciences and, more specifically, provide preliminary information on a group of 5th- and 6th-grade, Honduran students' conceptions of the Earth's interior. Understanding Honduran students' alternative conceptions in the geosciences is important because Honduras is at the beginning stages of developing a framework for geoscience education at the university level. Knowing what K–12 students understand about geoscience concepts may be beneficial in developing that framework. Furthermore, a better understanding of common alternative conceptions held by Honduran students will be helpful to both in-service and preservice teacher education in Honduras, assisting educators in the critical role of designing learning experiences that support students in revising these alternative conceptions in favor of more scientifically accurate conceptions (Bransford et al., 1999). Knowing about the alternative conceptions held by Honduran students may also be informative to teaching and research in other areas of the world where tectonic activity is prevalent but geoscience education represents only a small part of the national curriculum. That is, this study provides information on how a group of students with little formal Earth science education makes sense of what is inside

the Earth. In addition, alternative conceptions identified in this study may be useful to geoscience researchers and educators in the U.S. and Canada who work in areas with large populations of recent immigrants from Honduras or from other countries. The conjecture that some of the alternative conceptions identified in this study may have arisen after watching dubbed television programs needs further investigation; however, if it is true, it highlights the important role language and reading may play in the formation of alternative conceptions (Hawkins and Pea, 1987; Solomon, 1987; Strike and Posner, 1992). Students with limited language proficiency, as well as those who are emerging readers, may incorrectly assimilate information from television programs, books, or other sources into their current mental models. This is an important consideration for any educator working with language learners and emerging readers. Finally, representing what is inside the Earth is a difficult and abstract undertaking. Drawing tasks, like the one used in this study, may be a helpful tool that teachers can use to assess the range and common alternative conceptions held by students. Effective use of student-generated drawings throughout a unit may promote the construction of appropriate conceptual understanding, leading to conceptual change.

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APPENDIX 1. Interview Example for a Level 5 Student.

1. ¿Alguna vez ha estudiado o aprendido sobre el interior de la tierra? Si es así, ¿dónde y cuándo? (Have you ever studied or learned about the inside of the Earth before? If so, where and when?)

Sí, lo aprendí en estudios sociales el año pasado y miré un programa en el canal 6, Discovery. (Yes, I learned it in social studies last year and I watched a program on channel 6, the Discovery Channel.)

2. ¿Podría contarme acerca de su dibujo? (Would you tell me about your drawing?)

En el centro está el núcleo. Tomaría mucho tiempo viajar allí. Es caliente ahí abajo porque no llueve y la lluvia normalmente enfría las cosas. También recuerdo que aprendí que hay lava y otras cosas parecidas ahí abajo. (At the center is the core. It would take a really long time to travel there. It is hot down there because there is no rain, and rain normally cools things off. I also think I remember learning that there is lava and other stuff like that down there.)

3. Veo capas (lava, animales, árboles u otras cosas), ¿por qué dibujó usted éstos? (I see layers [lava, animals, trees, or other features], why did you draw these?)

Sí, creo que hay capas. Probablemente sólo siguen la forma de la tierra. La tierra es un círculo, por lo que probablemente las capas lo son también. Del mismo modo, dibujé líneas que representan la energía que sale del núcleo de la tierra. La energía es como un láser. (Yes, I think there are layers. They probably just follow the form of the Earth. The Earth is a circle so the layers probably are too. I also drew lines representing the energy that comes out of core of the Earth. The energy is like a laser.)

4. ¿Le gustaría contarme algo más sobre su dibujo? (Would you like to tell me anything else about your drawing?)

Sí, en el centro de la tierra hay un gran meteorito. El meteorito es el mismo que mató a los dinosaurios. Probablemente éste se hundió en el centro de la tierra después de que los mató. (Yes, in the center of the Earth there is a big meteorite. The meteorite is the same that killed the dinosaurs. It probably sunk down into the center of the Earth after it killed them.)

5. ¿Hubo algunas características adicionales que a usted le hubiera gustado haber incluido en su dibujo? (Were there any additional features you would have liked to have included in your drawing?)

No.