Applying argumentation analysis to assess the quality of university oceanography students' scientific writing

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Abstract

The purpose of this paper is to present the methods and results of our assessment of students' scientific writing. This study was conducted in an introductory oceanography course in a large public university that used an interactive CD-ROM, "Our Dynamic Planet." The CD-ROM provided students with geological data including earthquake locations and depths, volcanic locations, topographic elevations, heat flow distributions, and the relative age of islands which they may use to build their arguments regarding plate tectonics. We examined 24 student papers from this course and analyzed the quality of their written arguments by using two methods: (1) a grading rubric and (2) an argumentation analysis model. Quantitative analysis comparing the assessments made by these two methods produced disparate results. Through the presentation of samples of student writing, we demonstrate the application of the argumentation model. Finally, we discuss ways of using argumentation to help students understand how to tie data to theoretical assertions and to provide ways for students and teachers to assess the uses of evidence in scientific writing.

Keywords: Scientific writing – argumentation – educational technology – oceanography - instruction

Introduction

Geological data sets offer unique opportunities for engaging students in geoscience. Properly formulated pedagogical activity using these data sets can provide ways for students to learn geoscience concepts as well as scientific inquiry processes. Nevertheless, a number of challenges are posed for instructors of large-scale undergraduate courses interested in engaging students in inquiry processes that develop scientific reasoning, conceptual understanding, and proper levels of skepticism. These challenges include providing data sets that are readily accessible, but allow for multiple uses; designing activities that structure student work while allowing for sufficient student initiative; and creating methods for assessing complex tasks such as student reasoning. In this paper, we propose technical writing as a means to meet these challenges by engaging students with geological data sets.

Scientific writing is recognized as an integral part of the work of practicing scientists (Bazerman, 1988). The ability to understand scientific claims, critically examine scientific findings, and develop an effective scientific argument are important skills for scientists as well as citizens in a democratic society facing a myriad of techno-scientific issues. For instance, the status of scientific knowledge weighs heavily on interpretations of technology and environmental issues such as the role of human contributions to greenhouse effect, ozone depletion, and resource management. Thus, the ability to formulate valid arguments is becoming increasingly recognized as central to goals for science education (Duschl, 1990; Newton et al., 1999). For example, recent studies in science education have examined issues of student reasoning through argument and student conceptual and epistemic understanding of scientific argumentation (Forman et al., 1998; Duschl et al., 1999; Jimenez et al., 2000). Similarly, research in the field of "writing to learn science" (Keys, 1999) suggests the need to focus on epistemological issues related to the use of evidence in written knowledge. National scientific organizations (AAAS, 1993; NRC, 1996) have identified effective assessment and use of evidence in public and scientific discourse as a central component of science education standards. Nevertheless, our review of studies in science education suggests the genre of scientific writing specific to geological science is relatively under-researched (Bezzi, 1999).

In the following section of this paper we provide a description of the undergraduate oceanography course we studied. Then we discuss the research methods and the argumentation analysis model we used. Next we review the results of some of our empirical work on students' ability to build strong arguments and finally we discuss the implications for teaching.

Educational Setting

This study is part of a larger ongoing educational study of an introductory oceanography course in a large public university conducted over the past five years (Kelly et al., 2000; Kelly and Takao, in press; Takao and Kelly, 2001). We chose to study this particular course because of its use of technology and its emphasis on scientific writing in geological sciences. This undergraduate course satisfies a university writing requirement. Students are required to write at least 1,800 words in no less than 6 pages, double-spaced and not counting figures. A central educational component of this course and the basis for this study was the production of a scientific technical paper by each of the students. To assist students in their writing assignment, the course laboratory manual provided writing heuristics and examples of scientific writing. Students were instructed to organize their paper into the following six sections: abstract, introduction, observations, interpretations, conclusions, and figures (Prothero and Kelly, 2000). This writing assignment required students to characterize three geographical regions of their choice in terms of plate tectonics by using large scale data sets to build their arguments. Students accessed the data sets through an interactive CD-ROM created by the professor, "Our Dynamic Planet" (Prothero, 1995). Digital maps and charts were created as students plotted earthquake locations and depths, volcanic locations, topographic elevations, heat flow distributions, and the relative age of islands using the CD-ROM (See Figure 1). Students used the CD data as evidence for the theory of plate tectonics in particular to their regions of study. For example, a student may have chosen to study a subduction zone by accessing data such as topographical features, the location and frequency of earthquakes and volcanoes, seafloor spreading rates, or island ages for that region. More information about the CD-ROM may be found at http://oceanography.geol.ucsb.edu/.

Argumentation Analysis Model and Research Methods

In our study we applied two methods of analysis to examine the quality of students' scientific writing. First, a grading rubric designed by the professor was applied to each of the students' papers as a formal assessment. This rubric assessed specific features of students' papers including (1) stylistic features of writing, formatting, and labeling; (2) inquiry issues such as identification of a problem, statement of observations, distinction between observations and interpretations, conclusions supported by data; and

(3) uses of figures (for complete description, see Kelly and Takao, in press). However, this rubric did not adequately assess the strength of the written arguments which led us to develop a more sensitive measure of argument strength by examining ways students formulated written arguments (Bazerman, 1988).

Second, we developed an argumentation analysis model (see Figure 2) consisting of six epistemic levels (i.e., levels of generality of claim) and applied it to the papers (Kelly and Takao, in press; Takao and Kelly, 2001). The most specific grounded claims are shown at the bottom of the model (level I), progressively more general theoretical claims increasingly build on these as shown toward the top of the model (level VI). The categories for these levels are geological in nature and are as follows: (I) representations of data and geographical locations; (II) identification of features and frequency of features; (III) relational aspects of geological structures; (IV) illustrations of the authors' geological theories or models; (V) authors' proposed geological theory or model; (VI) general geological knowledge not specific to data presented. To examine the strength of student argumentation we sorted the sections labeled “observations” and “interpretations” of the assigned technical paper, sentence by sentence, into these six epistemic levels. This process allowed for ways of investigating how students use data representations to build theoretical arguments.

Our data set consisted of student technical papers (n=123) from which we took a random sample (Shavelson, 1996) of 8 student papers from each of the three graduate student teaching assistants' laboratory sessions to use in our study (n = 24). As previously mentioned, students were instructed to divide their technical paper into the following six sections: abstract, introduction, observations, interpretations, conclusions, and figures.

Our analysis was centered on the arguments presented in the “observations” and “interpretations” sections of the papers since, upon review of the student writing, we found that much of the inferential work was done in these two sections. Our unit of analysis was the grammatical sentence as punctuated by the student writers. The student marked sentences in the “observations” and “interpretations” sections of the papers served as the propositions sorted into the epistemic levels of the argumentation analysis model. In cases where students made more than one claim within a sentence (effectively more than one proposition) the sentence was noted at all appropriate epistemic levels. We labeled each sentence with an identification number which we call “proposition number” for future cross-reference and then sorted them based on the epistemic levels definitions. The specific methods for sorting each proposition from the sections labeled “observations” and “interpretations” of each of the papers into the relative epistemic levels is described in detail in Kelly and Takao (in press). Next we placed each proposition number on a semantic network which indicates whether the sentence is derived from the students’ observations section (proposition number is inside a circle) or interpretations section (proposition number is inside a square) (Figure 2). This semantic network also shows explicit links among propositions. Implicit links (e.g. sentences following a topic sentence with similar or illustrative content) are recognized as important for coherent writing; however, they were not labeled since they posed ambiguity in our analysis.

Analysis and Findings

Our analysis of the students’ papers was conducted in several phases. We present some of the summary statistics and quantitative analyses from our findings. These analyses include some descriptive statistics to give an overview of the model’s applications as well as considerations of reliability and validity.

In our first analysis, we considered the distribution of students’ propositions from their observations and interpretations sections across the six epistemic levels and noticed several general trends. First, in aggregate, the distribution of propositions showed the majority falling into the first five epistemic levels [n= 144 (level I), 116 (level II), 107 (level III), 96 (level IV), 176 (level V)]. Level VI, which was used less often in student writing (n=39), represents propositions which are not tied specifically to the area of study and often provide background information or define a concept. Second, the distribution of observations and interpretation propositions varied across the epistemic levels. The more specific grounded epistemic levels I, II, and III consisted of observation propositions (86%, 95%, 81%) more so than interpretation propositions. On the other hand, the more interpretative epistemic levels IV and V consisted mostly of interpretation statements (95%, 86%) rather than observation statements. This indicates the sensitivity of the argumentation analysis model as well as the students’ understanding of the instructional task: presenting scientific arguments grounded in data and building toward theoretical assertions.

We now present the argumentation structure for one of the 24 cases as an example of our analysis and classification system. This case (Heather) was rated high by both raters using the argumentation model and by the course instructors' using the course grading rubric. In our analysis of Heather’s arguments we numbered and sorted the propositions from the sections labeled “observations” and “interpretations” of her paper into the appropriate epistemic levels according to the model presented in figure 2. To briefly illustrate propositions sorted across the epistemic levels we consider arguments from the “observations” section of one of the three geographical areas Heather chose to study. The following represents the actual text presented by Heather in her paper as her observations for the region of the Kurile Island Chain. We have added the numbering to the propositions.

Heather’s observations for the Kurile Island Chain:

> **(1)** The Kurile Island Chain, part of the Eurasian Plate, is located Northeast of Japan and lies at the boundary zone between the Eurasian and Pacific plates (fig. 1). **(2)** To discern which type of tectonic boundary is represented in this area, I considered the topographic, volcanic and seismic properties of the area. **(3)** Figure 2 offers a closer view of the area to be considered. **(4)** The most notable topographic properties of this area are the trench, island chain and back-arc basin. **(5)** Notice the long, clearly defined trench along the East edge of the Eurasian plate, skirting the Kurile Island chain. **(6)** This is called the Kurile trench. **(7)** A more precise profile of the trench is plotted between 44.98N, 147.97E and 43.07N, 150.39E, (fig.3). **(8)** The depth of the trench at this profile reaches -8908 meters at the bottom, (notice graph in fig.3). **(9)** The island chain follows the shape of the plate boundary along the trench (fig.2). **(10)** There is what is called a back-arc basin to the West of the island chain (detail, fig.4). **(11)** This back-arc has the characteristic magmatic island arc and trench surrounding its shallow basin. **(12)** The profile in Figure 4, taken at 47.46N, 143.06E; 47.52N, 153.97E; indicate that at this location, the depth of the basin is a fairly constant -3360 m deep. **(13)** The Smithsonian Institution Global Volcanism Program and the corresponding dataset provides clear evidence of extensive volcanic activity on the rim of the Kurile Island chain, to the West of the trench, on the Eurasian plate as opposed to the Pacific (Fig.3). **(14)** The volcanic activity occurs approximately 96 km from the trench, in most cases. **(15)** Notice that the volcanic activity supports the notion that this island chain is indeed magmatic, and therefore characteristic of a back-arc basin. **(16)** The data set from NEIC provides information on seismic activity in the region (Fig.5). **(17)** There is a notable tendency for extensive earthquake activity along the boundary zone along the island chain, occurring both in the trench area and to the west of it, including the islands and the subsiding nearer the back-arc basin. **(18)** For a more precise look at the earthquake activity in this small area, I updated the profile in Figure 5 to include a detail of the earthquake activity along the profile. **(19)** This provided a remarkable example of a Benioff Zone, with its characteristic earthquake tending down and *towards* the plate, in this case tending toward the island chain. **(20)** Notice, in the graph in Figure 5, that the earthquake range in magnitude between 5 and 8 points on the Richter scale, and occur at a shallower depths near the trench and increasingly deeper depths as the occur nearer the continental plate. **(21)** The graph suggests that the range in depth of these quakes runs from 1-147 km deep.

Argument-specific figures cited:
Figure 1: World Map. Location of Kurile Island Chain and East Pacific Rise / San Andreas Fault Small Areas indicated.
Figure 2: Small Area Map of Kurile Island chain indicating topographic characteristics.
Figure 3: Kurile small area map with volcanic activity highlighted and a profile graph of the Kurile Trench at: 44.98 N, 147.97E; 43.07N, 150.39E.
Figure 4: Kurile small area map including profile of the back-arc basin and corresponding graph at: 47.46N, 143.06E; 47.52N, 153.97E.
Figure 5: Kurile small area map with earthquake activity highlighted and graph of plotted profile, indicating Benioff Zone at: 4 .98N, 147.97E; 43.07N, 150.39E.

Heather used topographic, volcanic, and seismic evidence to support her theoretical assertion that a subduction zone exists at the Kurile Island Chain. These three sub-arguments were constructed with claims across various epistemic levels. For example, consider the evidence she used for the seismic sub-argument. Heather referenced multiple data illustrations (epistemic level I) to provide support for her proposed geological theoretical claim, such as in proposition 18: "For a more precise look at the earthquake activity in this small area, I updated the profile in Figure 5 to include a detail of the earthquake activity along the profile." In building her argument she also identified features (epistemic level II) of the study area, "The graph suggests that the range in depth of these quakes runs from 1-147 km deep" (proposition 21). The relative geographical orientation of geological features is the next level of generality (epistemic level III) in the argumentation model and the following proposition (17) was classified as such, "There is a notable tendency for extensive earthquake activity along the boundary zone along the island chain, occurring both in the trench area and to the wet [sic] of it, including the islands and the subsiding nearer [sic] the back-arc basin." In addition, Heather used geological data to further illustrate her theoretical claim in proposition 19 (epistemic level IV), "This provided a remarkable example of a Benioff Zone, with its characteristic earthquake tending down and towards the plate, in this case tending toward the island chain." Our more in-depth analysis, beyond the few illustrative examples provided here, indicated that Heather built her argument for seismic evidence based on a range of data sources. Furthermore, she provided a set of claims spanning across epistemic levels as is typically the case in scientific arguments (Myers, 1997).

In our next analysis, we sought to compare the argumentation model with the results of the grading rubric. Based on theoretical considerations, we developed three criteria to evaluate and define what the argumentation model would predict as a successful scientific argument. The first criterion was distribution of claims across epistemic levels. Arguments that distribute propositions across epistemic levels in a relatively even manner would be rated as relatively strong. There is an expectation that a good argument will neither focus primarily on description of data files nor make theoretical claims without sufficient data. The second criterion was to consider the ratio of data propositions to theory/model propositions. Arguments that had multiple data sources (level I) for theoretical assertions (level IV and V) were rated stronger than those that made many theoretical assertions with little reference to data. The third criterion was the distribution of observation and interpretation propositions across levels. We gave stronger ratings to arguments that had higher observation proposition density at lower epistemic levels and higher interpretation proposition density at higher epistemic levels. All three criteria were used to rank, each with equal weight, the 24 student arguments from best to worst by two independent raters. The inter-rater reliability as measured by the Spearman rank correlation coefficient was 0.80. This gave us a measure to compare with the grades given to the students' papers by the geology graduate student teaching assistants of this course. As described earlier, the students' papers were formally assessed based on the grading rubric designed by the course instructor which focused on writing issues, inquiry issues, and figures. The points assigned to each of these three categories by the geology instructors were summed to yield a total score for each student paper.

Based on the total scores for each paper we created a ranked instructors' score for the students' papers. The Spearman rank correlation between the ranked instructors' score and the ranked argument strength from the argumentation model was low (r_{ranks}=0.12). The fact that these two independent methods for assessing writing gave disparate results led us to re-examine the two assessment methods: that of the argumentation model based on epistemic levels and that of the grading rubric. We continue to work on the development of an assessment method using argumentation analysis (Takao and Kelly, 2001). Nevertheless, the argumentation model can be used to help instructors and student writers consider the structure of formulating a written argument. In the next section we describe an exercise for readers to apply the argumentation model to examples of student writing.

Examples of student writing: Applying the argumentation model

The following two samples of student writing are from a previous academic year and were subsequently incorporated into the student laboratory manual to serve as a writing heuristic for the next cohort of students (Prothero and Kelly, 2000). We present these samples for analysis purposes. While neither example of student writing is an ideal, it is interesting to look at the differences and see what can be learned by classifying the sentences according to the epistemic levels previously listed. Interestingly, the better paper is easier to classify than the other. In these two examples, each proposition has been numbered. The figures have not been included, but their content can be inferred based on their respective context.

Paper 1:

Introduction

The area of study is the Kurile trench, identified as a small area on the class CDROM (fig. 1).**(1)** This area corresponds to a plate boundary thought to exist by geologists between the Pacific plate and the Indo-Australian plate (Segar, p62) **(2).** The data collected supports the theory of plate tectonics at a convergent plate boundary.**(3)**

Methods

The data includes topographical profiles created through the ETOP05 elevation dataset which consists of digital elevation data of sea floor and land.**(4)** The sources for this data come from: Ocean Areas—US Naval Oceanographic Office; USA, W. Europe, Japan, Korea, US Defense Mapping Agency; Australia: Bureau of Mineral Resources; New Zealand: Department of Industrial and Scientific Research; US Navy Fleet Numerical Oceanographic Center.**(5)** Gridded data varies in resolution from 5 minutes latitude/longitude to 1 degree.**(6)** Earthquakes are from USGS preliminary determination of epicenters and volcano data are from the Smithsonian Institution Volcano database. **(7)**

Observations

Three profiles taken along the coastal region of the Khamchatka Peninsula display the topographic features of an oceanic trench (see fig. 2 for profile locations).**(8)** Thousands of volcanoes exist parallel to the trench and 200-400 km inland (fig.2).**(9)** The trench lies at 60 degrees N latitude and 160 degrees E longitude and extends for 2,200 km in length along this coast.**(10)** One profile displays the gentle upward slope of the Pacific Ocean Basin which then becomes drastically altered by the sudden drop-off of the trench (fig.3).**(11)** Following the trench, a virtual linear rise occurs as the profile moves northwest and inland.**(12)** A second profile confirmed the presence of the trench 500 km to the south of the first profile, but showed a 400 km long basin located behind the vertical rise of the volcanoes. **(13)** The basin dips 3,000 m below sea level (fig. 4).**(14)** A third profile shows both the existence of the trench another 250 km to the south and the land features described by the first two profiles (fig.5).**(15)** Earthquakes' foci were also plotted along the same path as the middle topographic profile of the Khamchatka coast.**(16)** The plot shows earthquakes occur consistently along this trench (fig.6).**(17)** A cross section of earthquake activity along the middle profile shows a descending pattern of earthquakes to depths of 600 km (fig.7).**(18)**

Interpretations
Areas such as the Kurile Trench along the Khamchatka coast show the characteristic patterns of a continental convergent margin between two plates.**(19)** In this scenario, a plate containing oceanic crust collides with a plate made of continental crust**.(20)** One of the plates descends beneath another, into the earth's asthenosphere (fig.8).**(21)** A topographic trench is formed where one of the plates begins its descent.**(22)** This process is called subduction.**(23)** The sinking plate causes a corresponding pattern of deep earthquakes along its boundary.**(24)** Melting magma along the upper edge of the plate rises to the surface, creating volcanoes.**(25)** Figure 9 shows a cross-section diagram across the middle profile, showing the subduction model and observations of topography, quakes, and volcanoes that occur in agreement with the model.**(26)**

<u>Paper 2:</u>

Introduction
I will discuss the motions of the plates and their effecting result on the sea floor and the earth.**(1)** At the center of my discussion will be the Mid-Atlantic Ridge and why it has formed into an S shape.**(2)** It is an underwater mountain range, also known as an oceanic divergent margin**.(3)**

Observations
The Mid-Atlantic Ridge is a very interesting part of our Earth.**(4)** It is an underwater mountain range, also known as an oceanic divergent margin.**(5)** This ridge runs north to south down the center of the Atlantic from the North Pole to Antarctica.**(6)** Many different plates meet at the ridge including the North American, the Eurasian, the South American, and the African Plate.**(7)** The ridge extends at one point as deep as 5,625 m below sea level.**(8)** It stretches east to west from Europe and Africa to the east coast of the Americas, 2,547 km.**(9)** This is evident in Figure 1.**(10)**
An oceanic divergent margin means that the plates, which form the Earth, meet and disperse in opposite directions.**(11)** The resultant gap from these diverging plates is filled up with uprooted, low density magma.**(12)** This process leads to the series of volcanoes which form into a ridge in the gap left by the plates.**(13)** This process is known as sea floor spreading.**(14)** This is also illustrated in Figure 1.**(15)** The aging crust then sinks steadily down, while the mountains in the ridge slowly move outward while new ones fill in their place.**(16)** The mountains move in the direction of the plate.**(17)** This part of the process, combined with narrowness of the Atlantic and the shape of the continents, leads to the S shape formed by the ridge.**(18)**

Interpretations
My study shows the Mid-Atlantic Ridge is an oceanic divergent margin that is formed in an S shape due to many different factors including ocean size, plate motion, volcanic activity, and sea floor spreading.**(19)** This is proven by the data

> gathered from the map program and is reinforced by the area's topography, which includes volcanoes and earthquakes.**(20).**

As an exercise you may wish to sort the propositions from each of these two papers into their relative epistemic levels. Select the proposition numbers from each paper (a proposition may fit into more than one category) and classify them according to the six epistemic levels. You may wish to compare your results with our classification presented in Table 1. The epistemic levels presented below were taken from the course laboratory manual. To make the scheme more accessible to the undergraduate student readers of the laboratory manual, the course professor (author two) modified the descriptors from Figure 2 as follows:

Level VI.	Describe relationships between features or data and a theoretical model
Level V.	Describe a model or theory and/or a relationship between model features
Level IV.	Describe relationships between classified features
Level III.	Describe a feature that has been classified
Level II.	Name or classify an observation in terms of geological features
Level I.	Include an observation, or description of an observation

These two examples demonstrate the value of making evidential claims across a variety of epistemic level categories. For example, Paper #2 (rated as poorly written by both the argumentation model and grading rubric) has many propositions describing the model of plate tectonics (epistemic level V), but with few supporting references to classifications and observations (epistemic levels II and I, respectively). This indicates that the student was able to recite theoretical claims, but did not build an argument with supporting evidence. In contrast, Paper #1 made many references to data representations (epistemic level I), named features, and described geographical orientations of these features (epistemic levels II and III) in support of the theoretical claims (found in epistemic levels IV and V). The arguments in this paper could have been made even stronger by connecting in more detail the observational evidence with the theoretical assertions.

Discussion and Educational Implications

Writing scientific arguments requires a set of complex social and cognitive tasks. This complexity poses difficulties for writers at all levels of subject matter expertise. Nevertheless, the value of large scale data sets for engaging students in scientific inquiry should not be lost because of such difficulties. Rather, we draw three implications from these initial studies. First, there is a clear need to help students understand how to use data representations as evidence for more theoretical arguments. To this end, we have rewritten the laboratory manual to include aspects of the argumentation model. Science teachers can encourage uses of evidence in scientific writing by making the need for diversity of claims in an argument explicit to student writers. Specifically, by analyzing arguments by epistemic levels of claim, the structure of connecting theoretical assertions to data may become visible to students.

Second, the student writers need experiences receiving critiques of their own writing and analyzing others' scientific arguments. To this end the writing assignments in this course have been revised to require a larger number of shorter papers. This allows the instructors to provide students with more opportunities to improve their ability to construct strong arguments based on scientific observations and interpretations in their scientific writing during the course. To assist students in evaluating scientific arguments, online exercises are being created to provide both methods for analysis and opportunities to practice analyzing samples of other students' scientific writing following the argumentation model presented earlier.

The third implication concerns the socialization of geology graduate student graders. Much like writing itself, the assessment of writing is a complex set of tasks requiring skills gained through experience and education. For example, the teaching assistants who graded these science papers could generally recognize differences in writing quality, but sometimes had more difficulty explaining to the students the basis for their judgments. The application of the argumentation model led us to examine in detail some of the ways different readers interpreted student writing. The differences in assessments made by using the grading rubric and the argumentation model call for greater work among instructors in understanding the goals of the course, aspects of inquiry specific to geology (Ault, 1998), and ways arguments are formulated in science (genre-specific features of scientific writing).

The "Our Dynamic Planet" CD-ROM and accompanying teacher's manual may be obtained at the authors' web site at: http://oceanography.geol.ucsb.edu/

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Epistemic Levels	Proposition #'s for Paper #1	Proposition #'s for Paper #2
VI. Relationship between observed and model features	26	20
V. Describe model	19, 20, 21, 22, 23, 24	3, 5, 6, 7, 11, 12, 13, 14, 15, 16, 17, 18, 19
IV. Relationship between features	9, 13, 17	none
III. Describe feature	10, 14	8, 9
II. Classify Observations	8	none
I. Observations	8, 9, 11, 12, 13, 15, 16, 18	10

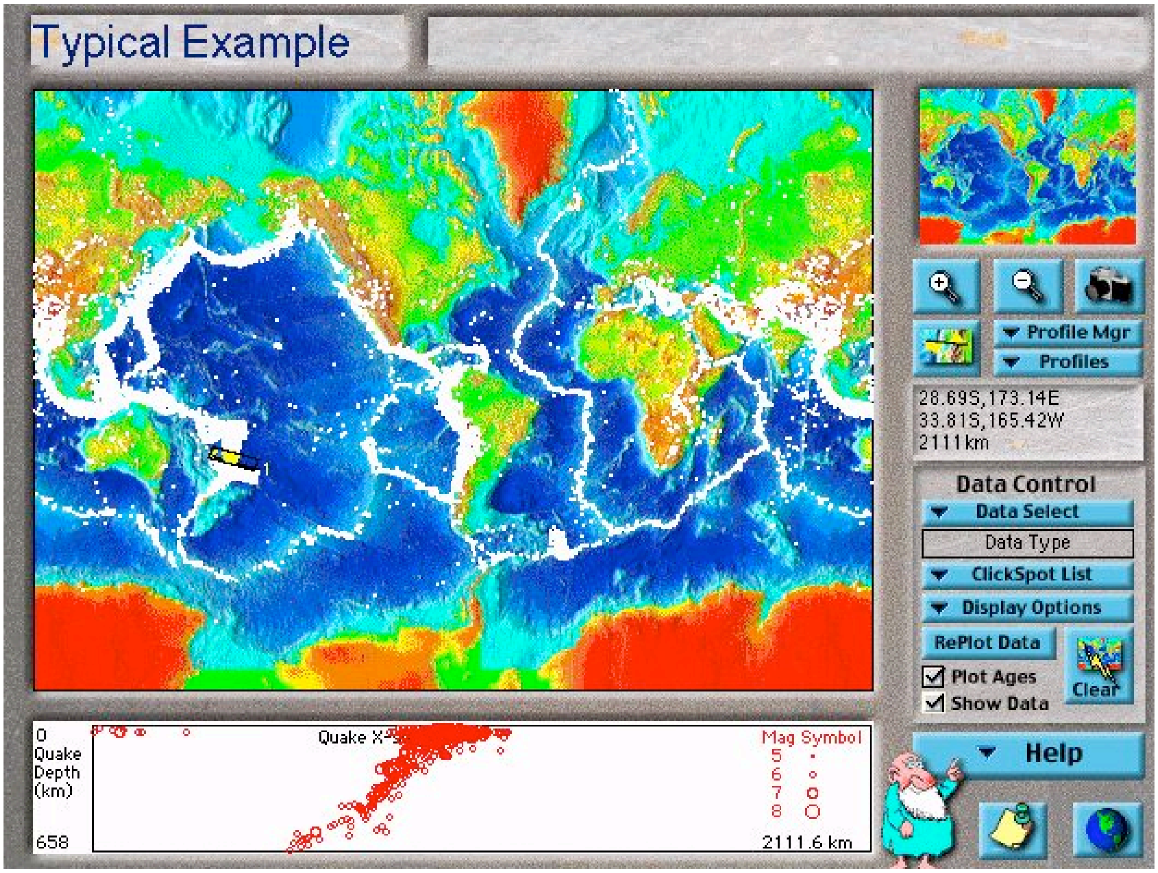
Table 1: Epistemic level classifications of student propositions from the two example papers: Paper #1 and Paper #2.

Figure captions

Figure 1: Map showing earthquake locations and earthquake depth profile for selected area.

Figure 2. Argumentation Analysis Model: Description of argument structure mapped according to epistemic levels.

Figure 1


Typical Example
28.69S,173.14E
33.81S,165.42W
2111km
Profile Mgr
Profiles
Data Control
Data Select
Data Type
ClickSpot List
Display Options
RePlot Data
Clear
Plot Ages
Show Data
Help
0
Quake
Depth
(km)
658
Quake X-S
Mag Symbol
5
6
7
8
2111.6 km