Processing the curriculum through quality questioning

by Jessica Gregerson

My eighth-grade Earth science students last year questioned everything. Sometimes they did it to try to get me off track, but mostly they were genuinely curious about the world around them. As I worked to find new ways to engage students and incorporate inquiry, I realized that their curiosity could be used to enhance our curriculum. In this project, student-generated questions became the basis for student-directed individual and group projects that provided practice with problem solving, critical thinking, and research skills while diving deeper into the Earth science curriculum. Using my students’ own high-level questions within our units provided relevance, challenge, and integration, and improved student engagement and motivation in my classroom.

Generating questions

The first step was to heighten student curiosity about the topics; when I used this project our units were Earth’s geologic history and astronomy. I engaged students by showing intriguing, short video clips and exploring vocabulary terms that would generate questions. I also told students which pages in the textbook went along with our unit so they could use it to get an even better idea of our upcoming topics. When they inevitably began to ask questions, such as “Why isn’t Pluto a planet anymore?,” I knew we were ready to move on.

As the next step, students brainstormed three or four questions they had about upcoming topics. Students began writing questions on their own, shared their questions with a partner, and then contributed their questions to the class list. After the brainstorming, I compiled each class’s questions into a separate file, as shown in the example in Figure 1.

The next day, we categorized the questions as “thin” or “thick” (Lewin 2010). We started with a mini-lesson using examples of the difference between thin and thick questions. Students understood thin questions when I explained, “You could ‘Google’ these questions and find the answers right away.” Thick questions do not have answers that we could look up quickly. They require us to find information from multiple sources and develop our answer over a period of time. There might not even be answers for some of our thick questions.

We then organized each question into either the thin or thick column on our SMART Board. To manage this process, groups of two students were given three to five of the class’s questions, and they decided if each question was thin or thick. As part of a class discussion, small groups would voice their decision, I would check if the class agreed, and then I would place the question into the appropriate column. During this process, I did not interject with my own opinion; students had the final decision. This was important because as students realized they made the final decisions, there was much more discussion and interaction. Many times we took a class vote on where to place a question, and if the vote was really close, we left the question in the middle so we could come back to it later. These conversations were some of the most thought-provoking discussions we had as a class, because students were arguing cases...
for questions that they and their peers had written. They felt ownership in the project from the beginning. When they finished, students chose at least one question they thought was not in the correct column and wrote down this question and their reasoning.

The next day, students discussed the questions they thought should be moved. More great conversations came from this process. Students who did not typically get involved in whole-class activities became very excited, especially when their own question was being discussed. After the discussion, questions moved or stayed based on a class vote. The next step involved students choosing which question they wanted to focus on throughout the unit. By this time, students were familiar with the questions, and most students had already decided which question they thought was most intriguing.

The first time I used this process for a unit (the Earth’s geologic history), students were assigned groups based on their chosen question. This was successful partly because I was able to pay attention to group dynamics and student interest. The second time (during the astronomy unit), I allowed students to choose to either work individually or in groups of two or three. One difference I saw between individual and group projects was that groups were generally able to address their questions from more angles than individuals. For example, one group was working to answer the question “How could life exist in other areas of our solar system?” and after some initial research found that they could better answer their question if they each learned about different celestial bodies, including Mars, Titan, and Europa.

During the process of choosing questions, we kept track of which questions were chosen. I required that each group have a different question to answer in order to provide our class with the most information possible when it came time for presentations. If the question was already a thick question, students were able to get right to work. If they were interested in a thin question, they had to expand it to make it a thick question. This often happened by beginning the question with “Why” or “How” or “What if...” or adding on “…and how do we know?” I made sure to let students know that if they began their research and found a new direction, it was fine to change their question completely or adjust their question after their research began, and many students chose to do this throughout the project.
Addressing the questions

Choosing the questions was one area of the project that allowed for differentiation. Students generally chose questions that aligned well with their abilities, and when I could see that a student needed to be challenged, I discussed with that student how to expand the question. Many students took the initiative to expand their question on their own, such as the group that changed their question from “Why don’t we grow pineapples in space?” to “How could we grow plants in space?”

Students had three days of in-class time to research spread out throughout the unit (over a period of two and a half weeks); the schedule depended on timing with the unit content and computer access. While students were researching, I moved around the room and had conversations with each group. These conversations gave students ample opportunity to obtain clarification and allowed me to monitor their progress on a daily basis. I kept notes about our conversations so that I could refer to them and keep track of the various projects. Students were reminded to use credible sources (e.g., sites ending with .gov or .edu) and how to effectively search online.

After researching and answering their question, students decided which would be the best way to present their information to the class: through a poster, a movie, a PowerPoint, or a Prezi (a web-based presentation tool). Students then presented their work to the class. An example of a group’s poster is shown in Figure 2. One requirement, as shown in the rubric in Figure 3, was that the presentation must be understood by the class, which
An example of a project rubric that assesses student work answering the question “How does land move?” This was from the first class to complete the project.

<table>
<thead>
<tr>
<th>Project rubric (50 possible points)</th>
<th>30–20 points</th>
<th>19–10 points</th>
<th>9–0 points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Did you fully address your question and provide enough supporting information?</td>
<td>Question was fully addressed from various angles. Information was compiled from various sources and enough supporting information was provided.</td>
<td>Question was addressed from a few different angles, but missing some parts. Information was used from a few sources, but more information is needed.</td>
<td>Question was only addressed on a surface level. Answer given was missing many parts and little information was given.</td>
</tr>
<tr>
<td>Was your presentation easy to understand and follow?</td>
<td>10–7 points</td>
<td>6–3 points</td>
<td>2–0 points</td>
</tr>
<tr>
<td></td>
<td>Presentation was clear and concise. Information presented was written in your own words and understood by the class.</td>
<td>Presentation was hard to follow, but included good information that was in your own words.</td>
<td>Presentation was confusing or incomplete. Information presented was clearly not in your own words and not understood by the class.</td>
</tr>
<tr>
<td>Did you provide the sources where you retrieved your information?</td>
<td>5–4 points</td>
<td>3–2 points</td>
<td>1–0 points</td>
</tr>
<tr>
<td></td>
<td>All sources are included with complete information in the journal and in the presentation.</td>
<td>Attempt is shown to include sources, but they are incomplete in either the journal or in the presentation.</td>
<td>Little to no attempt is shown to include sources. No sources are included in the journal or in the presentation.</td>
</tr>
<tr>
<td>Did you participate and contribute to your group in a positive way?</td>
<td>5–4 points</td>
<td>3–2 points</td>
<td>1–0 points</td>
</tr>
<tr>
<td></td>
<td>You stayed on task during class time and helped your group complete the project successfully.</td>
<td>You helped your group at times, but other times were off task and did not contribute to your group’s success.</td>
<td>You were off task many times and did not help your group complete the project.</td>
</tr>
</tbody>
</table>

was a challenge for many groups, because their questions and resulting answers were quite complicated.

**Reflections**

Although this project was extensive, it was an enhancement to our units and did not replace the unit content we learned as a class. Much of the questioning process was done in small blocks of time each day. We often worked on building our questions for 15 to 20 minutes and then continued with other unit content. After students selected their questions, we would often begin the class with a short assignment or mini-lesson, and when students finished they could resume working on their projects. I knew the project was going well when a student who was difficult to engage came into class and asked excitedly, “Do we get to work on our questions today when we finish?” and a similar student one day said, “I know this is out of the ordinary coming from me, but researching these questions is actually interesting.” Using the project in addition to our unit helped students make many connections between what they found relevant and interesting and the unit content. Many times throughout these units, when we got to a certain topic as a class, a student had already begun researching a related question and was able to become the class expert on the topic, boosting that student’s self-confidence.
One important thing I learned is that students improve their questioning skills quickly, making this process even more powerful after multiple uses. I first tried this with one of my five classes during the Earth’s geological history unit, so they repeated the process during the astronomy unit. This class generated far more and much higher-level questions (43 unique questions) than any of my other classes (average of 30 unique questions) during the astronomy unit. Students also gained an understanding of the importance of asking quality questions. As one student wrote, “The benefit of a thick question and not a thin question is that you get a lot more information out of it. So if I had to choose, I would pick a thick question.”

Some changes I will be making in the future include creating a daily checklist to be used by me and my students to monitor their progress, having students write their own hypotheses at the beginning, and writing plans and even experiments as part of students’ research.

Reference

Resources
Prezi—www.prezi.com. A unique presentation software that allows users to organize their presentation into a graphic organizer and store their work online.
Thick or thin?—http://hill.troy.k12.mi.us/staff/bnewingham/myweb3/thick_or_thin.htm. A teacher’s website, including more descriptions of thick and thin questions and many downloadable images for classroom use.

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