

Innovations in Thinking and Learning

Elaine Heaver – Mars Mission - Grade 6 Knowledge Building Experience

ELAINE: We just finished up a Science unit when we were doing biodiversity, and the sun had come up a lot, and the importance of the sun and how critical it was for life. So it segued nicely into a space unit that we were now starting. This was a grade six class. And as we segued into space, there were so many questions about space. It's such a vast thing. I didn't know where I was going to head. As a teacher, it's nice to know ahead where you're going to go, but I really didn't. There were so many different directions to go.

I invited an astronomer, and the astronomer came in. During the day he gave an amazing presentation. What he did was, he gave us knowledge to build as a foundation on. So he gave us that information at least we could start to learn. Then he came back in the evening, and we invited all the families, so the parents, grandparents, aunts, uncles, brothers, sisters all came. And he brings big, massive telescopes. And he gives a little sort of similar lesson to what he had done to the students for the parents, so they get to learn with us. They become our co-learners. We went outside, you got to look at the stars and Jupiter, and all the rest of it. And it was fun. We all had a good time. What that did was, it sort of launched us all into a learning partnership together.

So from there, I have recorded all of the questions the students have been asking the astronomer, when he was presenting some of the lessons. So then we also had other questions; kids put questions on sticky notes all over. So we had the students group the questions and kind of put them all together. And we found we could group them together to make bigger questions. All the questions with big bang theory, and all of that. We all said, "How did the universe begin," and other questions. And we took those questions and we put all of them around the wall, all of the walls around the room. And those became our knowledge-building walls. So the questions were at the centre of it. And then what I did was, I introduced a theory to the kids, the theory is a risk. You're putting an idea out there, and you have no idea what's going to happen to that idea.

So the students actually -- we had colour-coded papers, so the yellow, they would write down their theories. We had a few students that put theories on all the different questions that they were interested in. Then what happened next was, the students then went to research. And they researched to find out if these theories were viable or not. So if they found evidence that supported one of the theories, they would write it on, and they would put it by the theory. If they found evidence to discount it, and it was red for, whatever. And we had other things they could build on, they could still wonder. We had

all different kinds of colour-coding. These scaffolds helped the kids to identify what it was they were contributing to the conversation.

So they were identifying what kind of thinking they were having. Was it theory? Was it evidence? Was it a wondering? Was it building onto something? And so these became really useful as we were building our knowledge. Of course, the walls fill and there's no more space, and the thinking wants to continue. So we transferred this into the Knowledge Forum. And the Knowledge Forum is that digital tool that allows us to show our thinking, and it's an infinite space, so we could grow. The students were already familiar with the scaffolds, so they were able to enter in there and post their theories, build on each other's ideas, find their evidence, record it down. And they made their contributions.

The amazing thing about Knowledge Forum is that students own it. They own the learning, because they organize it. So when they make a contribution, they have to decide where that fits in in the view. And they have to decide when a new view is warranted. They have to decide when we've risen above something, and we want to show that. We've grouped thinking. So the students own that thinking in that digital world.

We also, as we started into and got launched into it, we invited the parents and families to join us as well. So on the Knowledge Forum would appear a contribution from a mom or a dad, or we had other staff members contribute. Our principal would post something. And the students were all over it, and it was exciting, because it was, oh, so-and-so's mom has just posted a question, I'm going to look into that for her. Or so-and-so's dad just put something about evidence to support, or discount something that I was looking into. We have brothers and sisters, all sorts of people. So it became our true learning community. It was a place where ideas lived, and they bumped against each other, and as a result, they really did thrive. That Knowledge Forum continued throughout the entire time we were doing our look into space.

What we did, though, was we wanted to focus on our particular aspect of space as a whole class. So without question, the most motivating part of the whole thing we were doing was the idea of the Mars Mission. At the time, they were just announcing that they had narrowed down to 100 candidates for this Mars mission where it's an organization that's sending people on a one way trip to Mars. The students couldn't believe that we would send people on a one way trip to Mars. They had a million questions, you know, "How will they do it?" "What will they do for water?" "How will they get food?" "How will they cope?" So we visited the website together of Mars One, and we read about their mission. And we found out that they are still -- first of all, it's an international effort, which

we were intrigued at. We liked the idea that there was people around the world trying to contribute to this. And we discovered that they didn't have answers to a lot of the problems that they needed to solve yet. So the class decided, well, why don't we solve the problems? Why don't we do the same problem solving that they're doing, and become part of their learning community?

STUDENT: We were just, like, solving problems that scientists were trying to figure out as well, because they're actually doing this Mars mission, and it's going to launch, like, the first people are going to launch in eight or nine years, I think, now. And two years later they're going to send a few more, and another few two years after that.

ELAINE: We listed what problems they were having, how to pick the crew members, who gets to go, what traits do they need. Things like how they were going to make use of the space they had, how the colony would be designed, and all of those questions. So we took on the same questions. The students were hoping that we would have insights that we could share with Mars One. They have a contact part on their contact section on their website. We were going to solve similar problems, and then share our insights with them. And the students were hoping that they could have a fingerprint in this part of history, and actually lay claim to a bit of helping out the Mars One mission as it progressed.

So we looked into different things. The first thing the students said was, well, we would have to decide who goes to Mars. We looked at it as -- again, our class was a knowledge-building community. The students -- everything happened through discourse and through collaboration. So the students together worked. They tried to think of what character traits you would need to go to space. And the students pooled ideas. And then they tried to group these traits. And they discovered this was really difficult. And it really gave them an appreciation of how complicated human behaviour is, because when they tried to group, you know, well, responsibility and loyalty and all, well, what is the difference between responsibility and loyalty and other things? The discussion really helped the students to get an appreciation that there aren't right answers. We don't know that the five traits a person needs to go to Mars are these five traits.

So the more the students delved into it, the trickier it got. They decided that if you think if criteria that would sort of mass decide who wasn't eligible to go, no smokers, no people who had any addictions to substances and all of that, they were debating who they would not allow to go. And this actually brought about great discussions about whose right it is to make calls. For example, some of the students were saying parents shouldn't be allowed to go, because they'd be leaving children behind. Then the debate was, well, is that their call or is that our call? And should a government agency or

another agency be able to dictate someone's decisions in their lives? Should a father of two young children be allowed to say, "I'm leaving forever," or would we stop that? And students had many different opinions, which was great, that different perspectives and ideas really pushed their thinking to new levels.

The students decided to design tests to see if they could see if a person had certain traits. When they tried to design tests for things like honesty and loyalty or responsibility, or bravery, courage, they discovered that one test can't do it. And again, it was that idea that there is no right answer. And the students were starting to get this idea that you could get your best idea out there, but it was still an improvable one.

They went through -- after the whole process of selecting and we even went through a process in our own class, trying to determine which of our students would be the best candidates. The students made out Googled forms and surveyed each other, and tried to determine in our class. After they did all that, it was a matter then of well, then, how would you prepare people? Four people who were going to leave planet earth forever and never come back. How would you prepare them physically, mentally, emotionally and socially? And students realized they really didn't understand the difference between mental and emotional needs. And so it came down to, what are basic human needs? Emotional needs, mental needs, social needs, physical needs? And again, there is no one right answer. And they realized how grey and convoluted life can be. They came up with their best ideas, and they kept changing those as we went on further and further. And we recorded our ideas all the way along, because students kept realizing, they kept going back and going, "I've changed my mind," or, "I've totally had a different train of thinking now," or, "I've redefined something." And I wanted students to see that, to see that we never stop learning and it continues to grow.

Students then, once we went through the whole thing of the candidates, it was that physical part, then, of the actual mission. They were really fascinated by the trip, the seven to nine month trip to get from earth to Mars. So it came down to, how would you best have this capsule designed? So then it came into math. Even though this is a science strand of space, we by no means stayed in science. There was language, there was media. There was writing and reading. The math component kicked in big here. They constructed possible models, shapes. They were trying to consider surface area versus volume, and they were building out of cubes. And they were trying to consider structural integrity for launches, versus comfort when they're in space. They made -- once, we tried to get into proportional reasoning. So once they made their models, we then had the scale of one to six, and the kids then -- trundle wheels and pylons, and tried to see how big it would actually be. And then they imagined, could four people live for seven months in that space, and what use would you make of it? We tried to keep

connecting it to the real world at all times, because we can all have kids make their little volume cube displays, but for what purpose? So we were trying to make it as real as possible.

We got into the whole thing of the water. We discovered from the Mars One website that they were able to take 3000 litres of water on this vehicle to Mars. And the idea was, the students were like, well, how long is that going to last them? For four people, is that just enough to get there for seven months? Or was it to last them a year, or six months? So then the students had to figure out how long would 3000 litres of water last for four people. So the math started. And the kids had to figure out how much one person usually drinks a day, and then a year, and all the rest of it. It was very authentic learning, and the students were very keen to find the answer for their purposes, for their reasons. They even got into the idea of the mass -- one of them was saying, "Well, how much room would that take up, 3000 litres of water? How much space would it take up? So then we got into the volume of it. So they started to discover the connections between a cubic litre of water taking up how much space, and how bit that would be. They got into the mass of it, because one of them was very intrigued about the fuel it would take for the launch and all of the rest of it. Not all the students pursued that, but this student was very keen. And he was saying, well, the launch, the 3000 litres of water would take up an incredible amount of fuel with the mass of it. So what is the mass?

So the students got into the idea of, well, how can we find the mass of 3000 litres? So we got the scales out, they're finding the mass of 500 litres, then one litre, and so on and so on. And that learning in itself -- the students had a bit of an epiphany, they actually thought, wow, this metric system is absolutely amazing. The relationship between the cubic litre and a kilogram, and just that capacity to volume, and everything was connected and related and so easily -- the students voted that whoever came up with the metric system should get a Nobel Prize, or something. They thought it was amazing. But their discoveries of this interconnectedness of things was because they were pushing to find out about their own wonderings.

As a wrap-up, what we did was, the McMaster University was offering viewing of a 3D documentary on Mars. So we took the students there and we had a private viewing, and two research students were there, two graduate students. And the graduate students had been doing this for several schools. And it was interesting, because they were asking, were there any questions. And the questions that the students were asking, the graduate students were telling me afterwards, weren't the normal questions they normally got. Normally they were getting questions about, why is it red, and where is the water, and all of that. They were a little taken aback by the depth of the students'

questions, and also the approach they were taking. It was not factual, it was more contextual with the idea of our lives compared to life there.

STUDENT: It was just video, and it had a lot of facts about the Mars One mission. It was interesting, it was fun. Surprisingly some of it, and a lot of it, we had already known. But it was really nice to go and see that and kind of touch base on everything else, that we keep everything in mind as a wrapping up. So I thought it was a great wrap-up for the unit. I think this topic is really interesting, and that's why I wanted to dig deeper.