

Folding Experience

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I thought it would be a good idea if people who visit the History of Science exhibit at Homi Bhabha Centre for Science Education (HBCSE) have a chance to do more than just look at the pictures and read the text on the posters. So I tried to think of some activity they could do with a few simple supplies - something which could be explained in a poster and could be done without any teacher or supervision. The simplest supply I could think of was a piece of paper, so I decided to look for an example of a science toy to make by folding a piece of paper (even scissors would not be required).

Unfortunately I did not take the time to plan the activity in advance, and children were already pouring in the doors for the Science Day celebrations! So I just looked through one of Arvind Gupta's books ("Aha! Activities") for ideas.

In this book there were some cartoons and the words of a song related to science education, so I printed them and posted them on a portable poster stand. The song was appealing because it related science to a social problem (militarism), and it was in the Indian context, so I thought it would be relevant.

I had A4 size paper, and I did not want to spend time cutting it into squares, so I found a science toy in this book which is made by folding a sheet of A4 paper. It was a box, which seemed familiar. Yes, it is a science toy - an experiment in how to turn a 2-dimensional piece of paper into a 3-dimensional useful box! I thought I had made it before and it was easy to make. I photocopied the instructions, posted it, and placed a pile of paper on the table beneath the poster.

Then I disappeared for some time. It was not easy to leave - I was thinking I should help the children make the boxes.

When I passed by the poster after half an hour, I noticed that a number of people were looking at the box instructions and folding paper. I was wondering how they were doing, but I did not want to interfere. I had noticed in the past that most people find it much easier to make things like this when someone demonstrates it to them than when they are given written and diagrammatic instructions. The cognitive act that occurs in these two ways of learning is completely different. Of course having a real person to ask for help is one big difference. But another difference lies in the difference between translating a 2-dimensional diagram onto a 3-dimensional object, and in understanding the series of diagrams as a time sequence of a process. I wanted to see if people would be able to use the instructions on the poster without assistance from a 'teacher'.

The next time I returned to the poster I found that no one was there at the moment, but there were several sheets of half-folded paper lying under the box instructions. There was no box. There was an ordinary paper airplane, but no box.

I went back upstairs to look for another paper toy to make. I found instructions for an "air propelled boat" in the same book - made from square paper. Something I had not seen before. I thought I had better try it first.

But when I tried following the instructions (in pictures and in words), I got stuck. Something was not clear in the instructions. I tried to find better instructions on the internet, but could not find them by searching for "air propelled boat" or various other key words. So then I studied the instructions I had. I finally figured it out, and I got a nice "boat" with a flat base and a perpendicular sail. I placed it on the floor under the fan and found that it did indeed sail around here and there.

It was a nice science toy. It was easy to make, but the directions were faulty and very difficult to follow. Anyway, I thought, let it be a challenge. Let's see what happens if I post these faulty instructions.

This is typical of the way I teach. Before I enter a classroom I usually have some idea in my head of what I want to teach - something I want to tell the students - something I think they need to learn from me. But then there is that moment when I find myself standing in front of all those eager children with a million things going on in their heads and my mind is racing and suddenly the sentence I am planning to say undergoes a mutation: instead of **telling** the students something I try **asking**. And I am always shocked - some student suggests a very good answer! I don't think I have ever taught a class in which I was not surprised to find that the students were more capable and more interesting than I thought they were. So now again, I decided at the last moment to see if anyone could make this air propelled boat!

I cut some squares, printed out a copy of the faulty instructions, and posted it near the box instructions. I noticed that now all the paper was gone from beneath the box instructions. I found that someone had cleared it off and stowed all the half-folded pieces of paper in a pile in back of the poster stand. It seemed that no one had succeeded in making the box - or maybe those who had succeeded had taken their boxes home. I put the half folded papers back under the box instructions with a notice: Do not waste paper! Reuse old paper. I was thinking that maybe I should have used sheets made from old newspapers instead of such nice new paper - I should have thought about this and prepared things beforehand.

After awhile I came back and found a crowd of children gathered around trying to make the box and the boat. But no one could do it. I decided to try to make the box myself. I found that even here the instructions were faulty. But I did succeed.

A number of children were crowded around me asking me to fix their attempt and complete it for them. Instead I asked them to look at the diagrams and try to do what the instructions said. I found it interesting that some of the children had a lot of difficulty in making a correspondence between the picture of a folded piece of paper and the actual folded piece of paper. For example when I held up their paper next to the picture which had a dashed line on it to indicate where to make the next fold, they had difficulty telling where the dashed line would be on their paper. I wondered if I had asked them to draw the dashed line on their paper how many of them would do it correctly.

Finally a few children succeeded in making their boxes. So I asked them to help the others. One boy immediately asked his struggling classmate to give the half-folded paper to him so that he could 'help'. 'Help' meant doing it himself. I asked him not to touch it but to tell his classmate in words what to do next. This was a daunting task - but perhaps a good opportunity to learn language skills!

A couple of children were planning to take home the boxes they made, so I asked them what they would put in their boxes. They considered a range of things from pencils and pens to peanuts to other food items. But the problem was that the box was not too sturdy since it was just made of thin paper. So we had a discussion about what would happen if the things were heavy or wet or oily. Another learning opportunity.

Then I looked across to see how another group of children was doing with the boat-making task. One boy said he had done it, but he did not have the proof in hand! Another boy produced a successfully made boat, but I happened to notice that it was the one I had made and left there in the beginning. A few children asked me to help. Instead I told them that it is quite difficult, but that I will give a prize to the first one who succeeds. I was sure that none of them could possibly succeed when even I had almost failed, so I was ready to suggest a rather ridiculously large prize. The children's incredulity brought me down to a prize of a Rs 5 coin which happened to be in my

pocket. And a few minutes later someone succeeded. I'm sure the Rs 5 was not necessary for this success.

At that point another teacher happened to come by and I explained to her how the instructions were faulty but still some children were managing to figure out how to make these toys. She suggested that we include some instructions that are easy to follow. I agreed, and we posted non-faulty instructions for making two more science toys from the "Small Science" books published by HBCSE: a very simple spinning windmill to balance on the end of a pencil, and a new kind of boat which the children probably had not seen before.

A number of children quickly made the spinning windmill. Then I noticed that the windmill one boy had made looked different from the one pictured in the instructions. A girl sitting opposite had made a windmill that looked just like the one in the instructions. I asked the children to figure out what was the difference and which one was like the one in book and which step in the instruction was done differently to get the alternative windmill - another learning opportunity.

Then I asked the children who were gathered around to tell me which of the two types of windmill would spin faster. It was interesting that some children responded by taking the two and trying them out, while others just gave me an answer, "that one", and others said, "I don't know". Then I asked them to "prove it". While some children had no idea how to "prove it" (or maybe they did not understand what I was asking), others tried doing various tests. Some got unexpected results. Some saw that the speed is not easy to measure or estimate. Another learning opportunity.

A girl came over and asked for a fresh piece of paper. I asked her to use one of the half-folded discarded pieces of paper. "Why waste paper?" I asked her, and we had a discussion about paper and trees. Another learning opportunity? Or just a moralistic command?

In the meantime a few other children were under the fan playing with their air propelled boats. They were challenging each other to predict which way their boat would turn. This led to their making small adjustments to the sails of the boats in order to make the boat turn one way or the other. Another learning opportunity.

You might criticise me for not planning things better and for not selecting a fully tested activity that I was sure would 'work'. You might say that I am just rationalising after being lazy. But, think about it, didn't this experience turn out to be more interesting than it might have been if it had been more carefully planned and tested beforehand? Weren't the children getting a taste of what science really is all about - asking questions, trying to find answers, testing, predicting, trial and error, communicating, observing, and so on?