

# TEACHING CHILDREN “HOW DO WE SEE?”

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*The purpose of this research was to develop a scientific way of thinking amongst students, by encouraging them to think and express in a logical & scientific manner. Generate their answers & cross check them based on the available information/Knowledge that they possess. Challenge the limits of their information with the common understanding or general knowledge. Here I attempted to break the myth that is well practiced and accepted. Conclusion: After the action research was over, it was observed that there had been a change in the thought process of the students not only in the science classes but otherwise too. Its impacts were noticed in History classes & in their attendance too. On certain festive days the increase in the attendance was shown & when asked, the students tried to come up with a question basically to understand the logic behind it. This change could be only a start if nurtured could lead to a larger & longer series of changes.*

## BACKGROUND

Grade 7 science books do have a lot of content related to the science but one of the objectives of science teaching is to develop a scientific temperament in the students which many of the science books present it in for of an activity to be performed. The major objective becomes to conduct the activity rather than developing a scientific bent of mind. Most of the experiments in the books become only a thing for validation of the pre-stated fact. Very less chance exists to disagree, redesign, re-conclude and improvise the experiments. Here the attempt was to understand the root of the issues with which children come and how this belief of the students could be challenged so that the process of logical thinking becomes more important than the conclusion.

## METHODOLOGY

Case study.

## OBSERVATIONS

### Day 1, Monday, July 29, 2013

Today, I had 3rd period in class 6th & the topic was: to introduce transparent, translucent & opaque objects. I was a co-teacher with Mrs. Shakuntala. The class started with our assumption that the students had some exposure to these terms as they had already been discussed by the chemistry teacher, Mr. Mohit Sharma, and he had told us that these students were familiar with these three terms. So we were quite relaxed. The class began with our asking for examples, prior to which they were asked to state the definitions - as they have understood from their previous classes. The students came up with the definition of transparent as “the objects through which we can see clearly.” Examples were air, glass, filter (Net), Mirror, Sari, etc... The next one was opaque & its definition was given as “the objects through which we can’t see” examples were – House, stone, Brick, Paper, Book, mirror, iron,

metal, etc... & for the translucent category the definition was “the objects through which we can partially see”. The examples were “Butter Paper, oil Paper, dirty water & fog/ cloud.”

By listening to the above discussion, I was a bit disturbed, as the base line of their definitions was clearly shaky, being based totally on vision & not on the property of transmission of light. (Eaton, Anderson & Smith, 1984).

So I thought, if this is how they have understood the optical property of the substance, they need to be checked on their understanding of vision. I wanted to know what the students thought about vision. To formulate it simply, I asked them to explain how they see things. Everyone was ready to state his/her own understanding of how (s)he was able to see anything. I sensed that they were certain they knew this because it is something which seems so obvious, that hardly anyone ever thinks about the depth of the process that is involved in the transfer of an external body to our own field of perception (vision). Many interesting points with examples came up, and as the question was asked, I invited the students to answer one at a time.

First, J (names with-held for confidentiality) said: “I know, light from our eyes moves out to the object, falls on it & this is how we are able to see that particular thing.” So this was considered as one point to which others could either agree or disagree.

Secondly, V said that she disagrees with J, as in her opinion, “some light from our eyes travels towards the surface & then it returns to our eye - which enables us to see the object.”

Further, there were some students in the class who didn't agree with either of these viewpoints, but said that these two theories are incorrect. Instead, they proposed that “Nothing goes out; only the outer light enters into the eyes.” This was Vi's point of view.

So I called for a vote after counterchecking that there was no other stand of anyone else in the class.

Now the condition was that each student had to either support one of the 3 groups or state their own theory (if they had any). They were also free to say that they don't have any idea. So leaving all three choices open, I asked them, one after the other, what their stand was.

Of 27 students who were present (out of a total of 29), 6 were in support of J. 18 students were in favour of Va, & the remaining 3 were in support Vi.

The next thing that I asked was how they knew that there is light in the eyes. I asked this of the group who said that the eyes emit light & also of those who said that there is a two-way process for vision. Here, the entire class had the same idea despite differences in their approaches. In this respect, the entire class seemed to be united with the idea of having a **मणि** or gem - that's what they called it. It was accepted throughout the class that there is something like *mani* in the human eyes.

Here I feel that the mistake not theirs, as it was very clearly pointed out by many of the students that they have heard - from their elders - that when a person has lost his vision due to some accident, it is said that “उस की आंखों की रोशनी चली गई है। This literally translates to “The light has gone out of their eyes.” So this implies that there was some light in the eyes which has been lost due to that particular accident.

Is it a careless mistake? But it may not be a mistake too, because that's the way Hindi is spoken. When I thought about it, I also found many idioms in Hindi, like “आंखों का तारा” &

“आंखों का नूर” (translated to “star of my eye” or “Light of my eye” – rather like the English idiom “apple of my eye”) which clearly gives an indication that eyes have got some type of in-built source of light. Thus, we have here a myth that is well carried and practiced. (See Lowe, 1986).

Now my basic problem is how to help the students arrive at the correct conclusion. Right now, I don't have any idea as to how I am going to take it forward but all that I know is that one day (later or sooner) they will explore it on their own. But as Newton said “Nothing moves on its own”, so I think I also need to push them. How? That is what I have to think about now.

\* \* End of Day 1 \* \*

## **Day 2, Tuesday, July 30, 2013**

I was working on finishing the monthly report for the month of July as it was to be dispatched by today evening & was a bit busy in collecting the data, photographs & typing them. At that time Mrs. Shakuntala stepped in & told me that the entire class was calling me (as I am the co- teacher with her). This in itself came as a surprise, because prior to this, they had never done so. I was also excited as now it had become my responsibility to take their interest forward (since I knew why they were calling me). I was also excited because last night, between sleep, I had planned my next set of actions, & was eager to implement these. I intended to inquire about the Mani factor by conducting interviews. I was also aware that because of this, the class should not miss the main topic which was about TRANSPARENT, TRANSLUCENT & OPAQUE substances. Keeping a balance was important. Everyone was painted by a brush stroke in the hue of PHYSICS, I could see it as I had had prior experience of it. This colour is impossible to define in terms of frequency, wavelength & other characteristics, but it resembles something like excitement, enthusiasm & everyone chattering in class only about vision: “How , what , who told you , & how does he know it?” This was the chattering heard. Now I knew it was the perfect time to hit the nail. But before I could have asked them anything, however, they started asking me who was right. I told them every one was correct because they told me what they knew or felt, & since it was their own observation who was I to judge it? “No, what we mean is - which group is correct?” While this was being asked I noticed that Va - who had earlier given the theory that light from the eyes goes out &, in turn, some light from outside enters into the eyes – was quiet.

So I left the question unanswered & asked her what had happened. “Why are you so quiet?” I asked.

She said: “I know that I was wrong” & as she admitted this, I could see a lack of conviction in her admission clearly written on her face.

“How? How do you know it?” I asked her.

“My father told me.” (Her father is a doctor).

“OK that may be so, but how do you see it? That's what really matters.” I countered

To which she responded that she still believed that what she had told was correct, but since she trusts her father & he is well educated, so what he has told her may be the only truth.

I let that rest. Now all the other students started asking the same question, “Which group was correct?”

I said: "I don't know."

Here they started arguing: "But how you can say thus?"

I tried to explain but before I could, they came up with logic that I might have learned it during my own schooldays. I made them silent & told them that what I had learned should not become a barrier for them to think, & it's not that everything is always written in books, there are certain points which we have to think & develop our own understanding about. Had it not been so, I pointed out, no new inventions or discoveries would have been possible, because then everyone would have looked into books for the final verdict.

Then I pointed to Va and said: "Science is always changing, & that's the nature of the subject. If something doesn't change it's not science, it's History (to my understanding), because history won't ever change - what has happened has happened. If Gandhiji was born on 2nd of October, it will never change to 31st of December. So what was correct a couple of years ago in Science may not be the same for the rest of the generations to come. These changes may or may not be visible in our life span, but they can always be challenged. So whatever your father said - it's you who need to analyse, check & make your own understanding. I don't want to say we should not trust our elders, but you must have a scientific approach to keep your understanding alive - otherwise it is others' understanding that is running through you!"

I don't know how far they understood this lecture, but they were mesmerized. So I came back to my point to ask what the Mani is all about. I anticipated that there would at least be a couple of answers & was ready to note these down. But to my surprise all the answers were the same. The entire class had a common understanding of the term Mani : "It is something which is very shiny, It's at the center of the eye." (See Reviews of *The British Medical Journal*, 1(2769), 200).

"But can we see it OR have you seen it or just heard it through someone?" I asked.

"We have seen it."

"Can you help me also to see it?" I asked.

"Yes!" the class said. "If you stand in front of a mirror & look very carefully at the center of your eye (inside the black circle) you will see a still smaller shinier object that looks like glass, and is black in colour." They continued: "It looks different from the outer black circle....." and thus, they went on explaining.

Now Va was also looking relaxed & was discussing the topic with others. I said I have also seen it, ah, so that's mani.

"Yes!" they all replied.

"OK...that may be so, but we need to check it in the class, & think about something which can prove the point that you made yesterday or the point to which you agreed yesterday. We will share our findings, experiences & demonstrations in the class on Friday. Will this time be enough?"

"Yes!" the class said.

We resumed our usual topic of transparent, translucent & opaque objects. I gave them a task - to think about the possibilities of the behaviour of light that falls on a surface. What all could possibly happen to light? The class was divided into 5 groups, where every group member was asked to present his/her idea. The entire class came up with three basic ideas:

1. The light can pass through the substance.
2. The light can't pass through the substance at all
3. Some of the light could pass through the substance.

So here, we didn't have any names for these three categories. I suggested that we now play a point game wherein I will write some names & they need to analyze them based on their statements as No: 1, 2 or 3. "You will get one point if you guessed it right & others could counter your arguments & if it's acceptable to the rest of the class they will get +2. If it's not agreed to, by the rest of the class, they will get -1. Simple rule - none of us will be winner or loser. It's just for fun."

Amidst much excitement, the game started, and I first wrote air & the red group said No.1 None of the groups came forward to counter this, "So it means that we all agree with this?" I checked.

"Yes!" came the resounding answer.

"OK, so we move to the next one - water..."

Again, the red group said No.1, but this time, the blue group came up with the point that it is not always No.1, it could be No.2 or No.3 also. This was a surprise for the rest of the groups because during their chemistry classes, they had seen it as a clear transparent substance, & I think, they were also told this by the teacher (I need to check it with the teacher). Interestingly, the supporting argument that the blue group gave was based on their daily observation from their surroundings. They asked – "How about the pond water these days (monsoon)?" Moreover, S asked: "Where will you put the ditch water? Will you not accept it as water?" The others agreed to this & they got +2. By now, other groups also realized that transparency depends on the level of purity, so they started shouting that even in the case of air it should hold valid.

I was confused - not just because I couldn't decide whom to give points to, but because the speed at which they learned this concept was in sharp contrast to the many years that it had taken me to grasp! Now there was a race of judging everything based upon this parameter.

The next object was paper for which one group (green) said it is No.2 whereas the orange group said it is No.3. Several supporting arguments were advanced but no one was ready to give up their stand.

So I stepped in & said: "Ok we will see this in the class."

I then brought an A-4 size sheet of paper & kept it against the light & kept my fingers behind the sheet. Then I asked the class: "Can you see my fingers? How many are they?" They were able to count & answered correctly.

Next thing I did was to add 20-25 sheets of A-4 size paper & repeat the same exercise, to which they replied: "No, we can't see through these." (Still, they didn't say *light can't pass through it* but that's OK.)

And a discussion immediately erupted across the class. This was the end of the period, so before leaving, I reminded them of the task that they were supposed to do for the next class.

\* \* End of Day 2 \* \*

### Day 3, Monday, August 5, 2013

The class was unable to find the answer to the question & was also held up. Today the topic of Transparent, Translucent & Opaque (See Ashbrook, 2009) continued as there was a basic shift in the level of understanding of the class from the previous definition - where they had said "Transparent objects are the objects through which we can see", "Through which we can partially see and "through which we can't see". Now a basic shift had occurred - that the Transparent objects "are the objects which allow the light to pass through them (Here the direction of the light is still under question)", "Allow the light to pass through them partially" OR "do not allow any light to pass through them".

I am happy with this transformation. I don't recall, in my own experience, whether these two definitions were different from each other at any time.

What I can recall is that I just mugged up the definition & kept on reciting it as & when asked. I feel that now I understand the difference between the two, to most people they may still seem the same. But it's a great change that I have felt. Still I am unable to bring the whole thing onto a platform such that the students may see the entire process clearly.

What should be done? Since last week I have a feeling that I need to interview the students separately, so that the idea of one may not influence other. Though in the class they all have discussed this issue many times, but still, I have a feeling that it may give me a direction to work further. So, I said: "I would like to talk to all of you but individually, & not in class."

This was quite a difficult task as it took a lot of time but there were many things that I got from the children. A, who was a supporter of J (the child who had said that the light moves out from the eye, falls on the object & that is how we are able to see the objects) said: "I know for sure that light is in our eyes because my uncle who is now blind told me, & even my mother confirmed it." I was surprised, so I asked: "What did they tell you? & how do they know it?"

He told me the story that a couple of years ago, in his family they had had a land dispute. His uncle who was involved in it - & till that time was OK - lost his sight during a fight when he got hit with a stick over his head.

“पर चोट लगने की वजह से उनकी आंखों की रोशनी चली गई। मम्मी और मामा दोनों यही बोलते हैं।”

(Translation – “But because he got hit on the head, the light went out of his eyes. That is what both my mother and uncle say.”)

It seems very clear that his belief is based upon the sound rationale that only if something is already present inside can it be lost. Otherwise, they would have said that something inside the eyes has been damaged.

One of the students, PB, who supported V, said during the interview that there is sufficient amount of light in our eyes & I have seen it too. During a dark night you can also see the eyes of the cat, they shine like fire.

I asked her: "But what about our eyes - why don't they shine?"

She had a very strange theory for this - she said in meat there are certain things (whose names she didn't know) which give light to the eyes. So all carnivorous (this term I am using, because she said meat-eaters) animals have got shiny eyes. But cows & other herbivorous animals don't have this, because they eat grass.

Some others who had said that nothing goes out from the eyes (like Vi) had no clue as to why they had said so. I was more interested in talking to the students who had come up with the idea of light as an external factor & suggested that it enters into the eyes.

While talking to them also, I discovered that they too had no clue as to why they had said so. Now I too was at a loss as to what to do, so as to enable them to get the right idea on their own.

I have to think but the thought that I had needs to be discussed with someone. Will it be advisable to share about the anatomy of the human eye? Because this is not included in their syllabus. My personal feeling is that the human mind is quite capable of understanding much more than we expect it to. Maybe the problem is from our side - we don't give - or we hesitate to give - knowledge. But on the other hand, my idea is not to impart knowledge; I am working on the creation of knowledge.

How to push them in the right direction? Here also I have a doubt - now what we are terming 'correct' may not be the absolute truth, so who knows? This may just be one of the most commonly believed facts, based on the tiny amount of knowledge that the human race currently has.

I feel totally stuck. At a dead end - because without the proper understanding of the prior concepts how can they reach a final conclusion? And even if they do so, it will be just an assumption. It's not as easy as I had initially thought it would be .....

\* \* End of Day 3 \* \*

## CONCLUSION

The approach adopted here in the classroom for a certain topic was just a way to develop a temperament of the scientific inquiry in a student, regarding which our constitution also talks. This approach holds good for most the subjects & all the topics. The beauty of it was that students developed a way of life. It can't be said that with this single time activity scientific temperament will be developed but it definitely will sow the seed of enquiring the things regarding why they are as they look to be. This brings a major shift in the way the child visualises the world around him, making an individual a critical thinker.

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