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The Science Association of Pakistan

SAP Newsletter

EDITORIAL

Dear Readers,
This is the SAP newsletter, which is once again in your hands. We are delighted that the new Editorial Team has been able to revive this tradition and we hope that henceforth it will be published regularly twice a year. We request you to send articles, news and views to include in the newsletter and make it truly yours.

Let us first introduce ourselves, the new editorial team to you our readers. Rehana is a teacher at the Beaconhouse School System and has regularly volunteered her time to SAP. Nelofer is a faculty at AKU-IED. With your support we hope to make this Newsletter a quality publication that is a regular part of your professional life.

With the new government initiatives to improve the quality and enhance the status of science and technology education in Pakistan, there is a need for science teachers to not only understand the content of science but also understand the nature of science. For this purpose this newsletter includes a brief introductory article on the nature of science. Another area of interest to our readers is more contextual and relevant information on science related sites. Ali Ahmed Jan has written a report on a water purification plant he visited in Karachi. The information he shares might be of interest to science teachers planning a field trip or developing an STS approach to teaching science. Mir Zaman shares his findings on children's ideas about matter. It is an eye-opener to see how greatly every day life experience influence children's thinking about science.

Please do share your views on the contents of the newsletter at sapnewsletter@yahoo.com. We hope to have another issue of the SAP newsletter for you in December. Khuda Hafiz till then.

Rehana Batool and Nelofer Halai

From the Chairperson

Associations after specific intervals undergo a process of administrative and organizational changes. These changes are an indication of growth of any professional association. Recently SAP has undergone the same process. Its organizational structure was revisited by SAP Working Committee. Elections were also held. I would like to take this opportunity to share with you the changes that have taken place in the SAP leadership and other committees. I, Farah Huma, have taken over the responsibility of being the SAP Chairperson from Unaeza Alvi. I would like to thank Unaeza Alvi for her valuable contributions to SAP as the chairperson and also hope that she will continue to contribute to SAP. Similarly, Suraiya Yousufi has become SAP's General Secretary. Rehana Batool and Nelofer Halai have taken the responsibility of the SAP Newsletter. I hope SAP will be able to serve you all with renewed vigour.

Farah Huma

School Science and the Nature of Science

By
Nelofer Halai
Associate Professor, AKU-IED

The purpose of this paper is to advocate that teachers be encouraged and helped to develop a clear understanding of the methods and structure of science, i.e., the nature of science (NOS). I have tried to define the concepts that constitute NOS essential for school science. I also want to highlight some of the challenges faced in attempts to introduce NOS in inservice teacher education in Pakistan.

Teacher education programs in Pakistan do not include NOS as part of their syllabus. However, the science curriculum for pupils from classes one to eight does address NOS by including, "scientific literacy" as one of the aims of teaching science (Government of Pakistan, 2000). My experience has shown that science teachers in Pakistan have not given sufficient attention to this essential aim of science education because their own experiences as science students has not prepared them to deal with this component of science. Furthermore, preservice and inservice teacher education programs do not prepare teachers to teach *about* science – the focus is more on teaching content knowledge and methods of teaching.

Rethinking Science Teacher Education

The curriculum reform in the 1970's and 1980's has encouraged a view that rejects the concept of a curriculum as an abstract concept, which has some existence outside and prior to human experience. "It is not on the teacher's shelf that one looks for the curriculum, but in the actions of the people engaged in education" (Grundy, 1987, p. 5). Within this conception of curriculum, teacher development and curriculum development are an interactive process. Many countries that are restructuring and reforming their educational systems and curricula to meet their present day needs, have recognized that the teachers are the key to educational change. That educational innovations cannot succeed if teachers are not taken into account is a lesson that is being slowly learnt. Hence, if change is to occur in the way science is taught it has to be mediated through the teacher. Only by bringing a change in the teacher's way of thinking, will the change be long lasting. Another reason that I advocate a rethinking of teacher knowledge about NOS is because it is always present as the "hidden" curriculum. The NOS has never been absent from the curriculum, it is just never explicitly stated.

Need for NOS in Teacher Education

Including NOS in school science is not a new or novel proposal. Consensus about the importance of NOS in school science is extensive; many different professional organizations such as the Association for Science Education (1981) in Britain and the National Science Teachers Association (1995) have embraced the call for including NOS in school science curriculum. Despite the prevailing consensus for demands for inclusion of NOS in school science there is ample research evidence that irrespective of academic background science teachers possess a limited knowledge about NOS (Koulaidis & Ogborn, 1995; Mellado, 1997). Tobin and McRobbie (1997) believe this to be a problem because the teachers' views of NOS can influence their students' conceptions of science. There is research evidence, though limited, that science teachers in Pakistan too have an inadequate understanding of NOS (Halai, 1999). Not knowing *about* science the science teachers continue to teach science as a collection of facts. The vicious cycle of science-as-collection-of-facts approaches to science teaching breeds students who go on to become teachers who emulate their teachers, and the cycle continues. It is important that this cycle is broken.

What is meant by NOS?

The dilemma is that before an understanding of NOS can be fostered in students, the science teachers need to have a fairly sophisticated understanding of it. The NOS, because it is both a problematic and contentious concept is difficult to define. Hodson (1991, p. 21) agrees and writes: "while it is apparent that no single, universally accepted view of science emerges from a consideration of the literature, there is a measure of agreement on a number of points relevant to the school science curriculum." The NSTA in a position paper (2000) has listed the concepts of NOS that are important for school science. I have provided, below, a modified version of this list:

- Scientific knowledge is simultaneously reliable and tentative.
- There is no single universal step-by-step scientific method.

- That observation is theory dependent.
- Creativity is a vital yet personal ingredient in the production of scientific knowledge.
- A primary goal of science is the formation of theories and laws, which are terms with very specific meanings.
- Contributions to science can be made and have been made by people the world over.

Challenges Faced in Teaching About NOS

While teaching a science methods course, I studied three elementary teachers' developing understanding of NOS while engaged in practical hands-on science. The predominant modes of data collection were interviews. The analysis of the data gives some understanding into how elementary teachers, who do not necessarily have preparation in science, learn about NOS in the context of Pakistan. The findings indicate that practical, hands-on activities are helpful, but there is a need for more overt teaching of NOS and explicit discussion of the concepts of NOS as they relate to each practical activity. The two teachers who did not have a background in science had difficulty in border crossing from their own subject sub-culture/s to the culture of science. But the surprising finding was that the third teacher who was a science teacher had greater difficulty in accepting ideas about NOS such as: most scientific observations are theory based. It is my conjecture that the science teacher being socialized in a very positivistic conception of science had more difficulty in changing beliefs, as compared to the other two teachers, who did not have much experience of learning and teaching science.

It is clear that developing an understanding about NOS is very important for science teachers and science teacher educators. This study gives an insight into the difficulty of the process of bringing about such change. It has also raised a number of questions, the most important being: What does NOS mean in the context of a Muslim society like Pakistan? I support an inquiry approach to the introduction of NOS to teacher education curriculum in Pakistan so that we learn in the process of implementation of this policy.

References

Association for Science Education. (1981). Education Through Science: An ASE Policy Statement. England: Author.

Government of Pakistan. (2000). Science curriculum classes 1-8. Islamabad: Curriculum Wing

Grundy, S. (1987). Curriculum: Product or praxis. London: The Falmer Press.

Halai, N. (1999). Elementary teachers learn about the nature of science: New frames for experience. Paper presented at the annual meeting of the American Educational Research Association, Montreal, April 19-23, 1999.

Hodson, D. (1991). The role of philosophy in science teaching. In M. R. Matthews (Ed.), History, philosophy, and science teaching: Selected readings. New York: Teachers College Press.

Koulaidis, V., & Ogborn, J. (1995). Science teachers' philosophical assumptions: How well do we understand. International Journal of Science Education, 17(3), 273-283.

Mellado, V. (1997). Preservice teachers' classroom practice and their conceptions of the nature of science. Science and Education, 6(331), 354.

National Science Teachers Association. (1995). A high school framework for national science education standards. Arlington, VA: Author.

National Science Teachers Association. (2000). NSTA position statements: The nature of science. [On-Line]. Retrieved October 4, 2001, from http://www.nsta.org/159&id=22.

Tobin, K., & McRobbie, C.J. (1997). Beliefs about the nature of science and the enacted curriculum. Science and Education, 6, 355-371.

The next newsletter will be published in December 2003

Please send your articles, suggestions and letters for next publication latest by 15 October 2003.

The Editors

SAP - Newsletter

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Karachi, Pakistan

Contamination of Water and its Purification in Karachi: A Report

By

Ali Ahmed Jan

M.Ed. Student, AKU-IED

Every plant, animal, and human being needs water to stay alive. We need water in our homes, to brush our teeth, cook food, and wash dishes. We need water in our factories. We need water for irrigation to raise crops. We need water for our animals. But the question is which type of water? Certainly the answer will be purified water that is suitable for drinking. By pure, I mean water fit for human consumption that does not have physical, chemical and microbiological pollutants.

Purification

Water can be purified in a number of ways: distillation, filtration, reverse osmosis, use of chemicals such as chlorine, by ultra violate rays and the most common household method of boiling.
The purpose of this report is to present how water is purified in the Karachi COD plant.

Brief history of Central Ordinary Plant (COD):

I visited the plant three times to meet with people working there and observe the function of the plant. I found that in Karachi, many plants are working to provide drinking water to the citizens, but COD is the biggest plant. It is situated at Gulshan-e-Iqbal, University Road, Block 17 (Ph: 9243801). In this report I have focused on the working of this plant. By interviewing an engineer I found that this plant was made in 1960 and extended in 1970. This plant is treating water through filtration and chlorination, no other process is involved. In the beginning, pumps using oil were utilized to pump water but they were soon replaced by electric pumps as they were cheaper. However, now the whole filtration process works by "gravity", where the water at a height flows into the filter beds on its own.

In COD, two plants are working: a German plant, and a French plant. The German plant is more powerful than the French plant. The capacity of purifying water of German plant is 70 Million Gallons Per Day (MGD), and for the other plant it is 45 capacity MGD. The main source of water for this plant is the Indus River, which feeds the Kaleri Lake. We don't need any pump or engine to lift the water. Allah has blessed us with a natural lake, which is called "Kaleri Lake". Its height from the COD plant is 160 feet. That is why water flows by gravity from lake to COD plant.

Process of Purification in COD Water Treatment Plant

As I mentioned above that water supplied to the public must be free from impurities. Impurities can be insoluble (such as clay, silt, and micro-organism) or soluble (such as industrial or agricultural pollutants and dissolved organic compounds). All these impurities must be reduced to safe amounts before the water is piped to homes and factories. There is no universal way of purifying water. The method used depends on the local situation, but most waterworks carry out the jobs listed below.

Water from the River Indus feeds the Kaleri Lake North of Karachi. From the lake the water is sent to Dabeji through a canal and then piped to the COD plant in Gulshan-e-Iqbal for purification. It is then distributed to various pumping stations to be pumped to consumers. One such pumping station is located in Federal B Area, and because of that the whole area is called "Water Pump".

Step 1: The water that reaches COD Dabeji is mixed with chlorine through a chlorinator, which prepares a proper dose.
Step 2: From here the water goes to the mixing basin where Alum and other chemicals are added to the water. Bacteria, silt, and other impurities stick to the alum and settle down.
Step 3: The water then enters the filter beds, made of crushed stone, which screen out any remaining impurities.
Step 4: The filtered water collects in a clear well and then flows to a reservoir, where it receives a final treatment with chlorine, which is called post chlorination.
Step 5: The purified water is then pumped to consumers through underground pipes. Water is also sent to consumers through tankers.

Is this purified water clean?

Research shows that unlike most germs, the chlorine does not kill cryptosporidium. It is too small to be seen without a microscope. When people get infected with cryptosporidium they can have watery diarrhea, stomach cramps, an upset stomach, or a slight fever. Boiling water is the best method of killing

cryptosporidium. Water should be brought to a rolling (continuous) boil for one full minute. After the boiled water-cools, it can be stored in a clean, sealed bottle or pitcher with a lid and used normally. In the above-mentioned purification process there is no boiling system so this shows that this water is not 100% clean. Ideally, treated water should be consumed immediately after treatment to prevent deterioration. Some types of bacteria can grow in almost any water, especially at warm temperature. If water is not to be used right away, it may be stored for no more than a few days in the refrigerator.

Discussion

While working on this report I collected a large amount of material on water purification pertaining to Karachi and this experience of working on a real-life project gave me in depth understanding about the water issues of the city of Karachi. From the interpretation of collected data I understood that in Karachi, where diarrhea is the leading cause of childhood death, municipally (locally) supplied water is heavily contaminated with faecal organisms. Contamination can also take place during transmission or storage.
The World Health Organization (WHO) estimates that up to 90% of the water Karachi's residents get is not fit for human consumption because it contains faecal matter and harmful bacteria.

Recommendations

Unpurified drinking water may contain four things that pose health risks: protozoan parasites, (e.g. giardia) toxic bacteria, viruses, and poisonous chemicals. The quality of water is decreasing in Karachi day by day by increasing population. The WHO (world health organization) estimates that up to 90% of water Karachi residents get is not fit for human consumption, because it contains faecal matter and harmful bacteria. On the light of the above mentioned facts I would suggest that:

- The government should undertake a massive exercise on a war- footing to improve the quality of drinking water. Water purification techniques employed at reservoirs should be checked regularly to see how effective they really are and if found deficient, better technology should be used.
- Through campaigns and media, people should give awareness about the consumption and conservation of water.
- Cheap and alternative ways of purification should be introduced.
- All people should boil the water before using at homes.

Bibliography

Mcliesh, E. (1997). Keeping Water Clean.
Italy: Way Land (publishers)

The World Book Encyclopedia (1994) W.X.Y.Z Volume 21.

Hoong, T. & Leing, H. (1997) New Lower Secondary Science 2.

Singapore: Pan Pacific Publication (S) Pte. Ltd.
Cowasjee, A. (2000). Clean Water, Please. Source Dawn
http:// www.Dawn.com/2000/11/20/ed.html

Siddiqui, S. (2001). Is Your Water Safe for Drinking? Source: Health line.
http://www.defencejournal.Com/globe/2000/june-july/water.htm.
Luby, S. et. al, (2000) A low-cost Intervention for Cleaner Drinking Water In Karachi Pakistan. Source: Safe water system. File;//C:\Documents % 20 and 20settings\ali.jan\Local%20settings\Temp\Safe%20 Wat….

Source: Centers for Disease Control and Prevention
http://www.cdc.gov/ncidod/disease/crypto/cryptos.htm

List of SAP working committee

1. Ms. Farah Huma, Chairperson, Habib Girls' School.
2. Ms. Suraiya Yousufi, General Secretary, Orient Pak. G.B.S.S, North Nazimabad
3. Ms. Arshia Saeed, Habib Girls' School.
4. Ms. Ismat Jehan, Govt. G.S.S Sir Syed town.
5. Ms. Mehnaz Fatima, Govt. Girls College Nishtar road.
6. Ms. Rehana Batool, Beaconhouse School Systems Cambridge Branch, N. Naz.
7. Ms. Rukshanda, P.A.F Degree College, Faisal.
8. Mr. Shahid Pervaiz, SMS, Karimabad
9. Ms. Tahira Firdous, Habib Girls' School.
10. Ms. Unaeza Alvi, Senior Instructor, IED.

INQUIRY INTO CHILDREN'S CONCEPTIONS ABOUT MATTER

By
Mir Zaman Shah
M.Ed. Student, AKU-IED

Students' minds are no longer considered an "empty vessel" having no ideas about the environment. They develop certain concepts about their surroundings on the basis of daily experiences, even before starting their formal education in schools. These ideas play a very important role in the process of teaching and learning. The elicitation of children's ideas raises the teachers' awareness of the perspectives pupils may bring to the classroom, their learning needs and the common alternative frameworks about the scientific concepts children acquire due to various reasons.

This is a brief report from our more extended inquiry on children's conceptions of matter. Three of my colleagues and I interviewed five students of class four. We also provided them with some samples of matter and asked them to classify them in solids, liquids and gases. The findings from this inquiry are:

Rote Memorization

The children explained the concept of matter as, " all the things that are around us are matter. Matter has mass and occupies space". They could not elaborate the concept of mass and the characteristics of matter. Thus, it was evident that children had memorized this definition from the book.

Teaching and Misconceptions

They explained matter as composed of tiny particles known as atoms. Two out of the five students said, " Atoms are very small, we cannot see the atoms". But the others considered the chalk dust as atoms of the chalk. This is a misconception, which children usually develop about atoms because of what they read in textbooks and the instructions they get from the teachers. If a teacher gives the example of chalk dust to explain the particles, s/he should further add that the particles are even smaller than that so that the children can be clear about the concepts. Similarly, it is safe to use the term particles instead of using atom or molecules because these are complicated aspects in relation to learning concepts at the primary level.

This shows that sometimes textbooks and teachers also create misconceptions. One reason might be that all children do not internalize the concept presented by the teacher in the way we as teachers usually perceive it. The result is that children do not develop a conceptual understanding of the topic.

Three States of Matter

The children knew about three states of matter that is solid, liquid and gas and could categorize them appropriately. However, in a few cases, we found them to be confused in grouping some of the materials such as shaving foam, coke etc. on the basis of the criteria they had developed for classification. The pupils described solid as "Solid are hard…the particles of solid are closed and stick together… and therefore, the particles do not move". The common property children used to define a solid was *something hard*. Such understanding often leads to overgeneralizations. For example, on the basis of this property they could not decide about the state of fine powder. One of the children said, "When powder is in a bottle, it is solid, otherwise it is not solid because it is not hard".

When they were asked about the characteristics of liquids, they frequently attempted to relate liquids with water using words *something like water*. They described gas as, "We cannot see the air, and it is all around us, and the particles of gas are very far from each other". They used the words air and gas interchangeably but could not differentiate between them. They could not identify any other property of a gas such as volume, shape etc. Their every day experience of using gas and air was confusing for them. For example, they said, "Gas has color while air is colorless…we breathe and take the air in, but we cannot take gas in… a gas is used to cook something". It was evident from their discussion that they had been taught the concept of matter but still it was not very clear, and so they continued to hold their every day life's beliefs instead of basing them on scientific reasons.

Implications for Teaching

As a teacher I found that children's ideas have a number of implications for the science teacher:

- Exploring children's pre-conceptions and taking them as starting a point will facilitate in developing their conceptual understanding.
- Providing children with ample opportunities to be engaged in hands-on activities and holding interactive dialogues with them are necessary in developing a clear concepts among children.

- An ongoing assessment and timely feedback also contribute significantly towards effective learning.
- Using reference books to update the scientific concepts, and reflecting on the teaching learning process also improves instructions.

Conclusion

The analysis of the data shows that in general, the children may know the "book" definitions of matter, solid, liquid and gas but their understanding was usually incomplete. Their intuitive perceptions were more dominant over the ideas taught formally in the classroom.

SAP's Participation in 2nd International Conference on Physics Education

SAP participated in the 2nd International conference in Physics education organized by Center of Physics Education, APWA College, Karachi, National Center for Physics Quaid-e-Azam University Islamabad, and Department of Physics University of Karachi. Participants from different countries and all over Pakistan attended the conference and presented their papers. Farah Huma and Suraiya Yousufi represented SAP in this conference. They gave presentations on "existing practices of Teaching Physics in Private and Government Schools" and "activity based learning". SAP's participation in this conference was highlighted and brought into notice the existence of SAP at an international forum. All the conference participants showed their interest in getting more information about the association.

SAP CHILDREN OLYMPIAD

In December 2002, SAP introduced the idea of a **Science Olympiad** for science pupils in Karachi. The aim of this event was to introduce new methods of science teaching and learning, like hands-on activities, puzzles, problem-solving activities, etc., to the students in schools in and around Karachi. The activities in the Science Olympiad could also give teachers ideas of how to use simple activities in their classroom and make their teaching more interesting. More than ninety students from grade seven and eight, from schools in Karachi took part in the event. One school from as far away as Larkana participated in this competition.

The whole event was divided into four categories: puzzle, construction, investigation and problem-solving. The participants were allowed to participate in any one category. The facilitators went round the room offering help, clarifying instructions where required. At the end, a brief presentation was made by the winners of each category, followed by the prize distribution ceremony. Certificates of merit were awarded to the winners of each category and certificates of participation were awarded to all participants.

The participating schools and pupils greatly appreciated the effort of SAP and suggested that this type of event should be held regularly.

Newsletter editing and design:
Karim Khan & Rehana Batool

SAP FUTURE PROGRAMS

During the course of the current year, i.e., the year 2003, SAP plans to organize a variety of professional and academic events for the members. Details of the activities are given below:

SATURDAY WORKSHOPS:

On the second Saturday of every month, from 9 am – 12: 30 pm, SAP will organize workshops on various topics of interest to science teachers at no cost to them. For registration call Mr. Karim on working days between the 25-30th of every month. He is available at Phone No.: 6347611-4 Ext: 3076. Please note that registration is on first come, first serve basis. Schedule for the upcoming workshops is as follows:

DATE	*TOPIC*
10th May	Skill based assessment
14th June	DART Activities
9th Aug	Resource Development
13th Sep	Use of I.T in Science Classroom
October	Annual Event
8th Nov	Project Work
13th Dec	Inquiry in science

Note: Any change of date or topic will be informed to our members through circulars.

SAP SYMPOSIUM

SAP Symposium is a major event organized by SAP, which is very popular not only among our regular members but is also highly appreciated by non-members too. It is always scheduled in October on the anniversary of SAP's formation. The purpose of this symposium is to promote the professional development of science teachers and provide a forum where the latest developments/issues in science education is aired and shared. Sap members will be informed about the exact date and time of the symposium later.

SHORT COURSES

SAP is planning to organize some short courses during the summer vacations at AKU-IED for the professional development of science teachers. Members of SAP will be informed of these short courses at a later date.

Membership Regulations

Three types of memberships are available at SAP which is as follows:

Teacher Members:

Any science educator teaching at any educational level is eligible to become a member of SAP. Membership fees are Rs.200 per annum.

Associates Member:

Persons not teaching science but interested in science can become associate members. Membership fees are Rs.200 per annum.

Institutional Members:

Educational institutions / teachers' training institution / any other institution associated with improving the quality of Science education or disseminating science knowledge can become an Institutional member of SAP. Membership fees are Rs.500 per annum.

For school system with a number of schools each school will have to register separately.

Resource Persons

Interested persons and teachers who wish to join SAP and contribute towards the improvement of quality of Science teaching and learning should fill in the Resource Person forms. These forms are available at the registration counters of workshops and may be submitted after the workshop. Mailed to IED or to Farah Huma (farah.huma@hotmail.com).