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<th>Title</th>
<th>Teaching observational skills in science</th>
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<tr>
<td>Author(s)</td>
<td>Goh, Ngoh Khang &amp; Chia, Lian Sai</td>
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<tr>
<td>Source</td>
<td><em>Teaching and Learning, 7(1)59-65</em></td>
</tr>
<tr>
<td>Published by</td>
<td>Institute of Education (Singapore)</td>
</tr>
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In scientific investigation, observation is the most fundamental of process skills. This is because observation is the way we receive information and it subsequently forms the basis for further development of other process skills. In general, if an observation is made wrongly, the actual outcome may be different from the expected one. Thus, an incorrect observation always leads to an inappropriate inference.

Although scientific observation on its own is fundamental and important, it is by no means always a simple task. In fact, according to Norris (1985), it varies from simple activities (requiring little preparation and unsophisticated interpretation) to extremely complex activities (among the most challenging tasks in which human beings engage).

Difficulties in Observation

It is a common experience that not only primary school children, but also students at secondary and tertiary levels encounter difficulties in observation. According to our experience, factors contributing to such difficulties may be summarised as follows:

1. Intuitive ideas of the observer

Through personal experiences from daily life, either in a formal or an informal way, children may form their own way of thinking and explanations about the object or phenomenon observed. The result of the following test will illustrate this fact clearly.
Five different people look at this picture

John says: The radiator has been turned up too high.
Mary says: The vase has no water in it.
Jane says: The flower stems are too weak.
Peter says: The vase has dropping flowers in it.
Pat says: The people must be away in this house.

Who sticks closest to what they can see without jumping to conclusions?

Put a tick in the box next to the person you choose.

% of student response

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<tbody>
<tr>
<td>A</td>
<td>John</td>
<td>26</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>B</td>
<td>Mary</td>
<td>15</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>Jane</td>
<td>2</td>
<td></td>
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<tr>
<td>D</td>
<td>Peter</td>
<td>43</td>
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<td>E</td>
<td>Pat</td>
<td>10</td>
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[Key]
The test is reported in the science report "Science at Age 13" of the Assessment of Performance Unit (1984). All the distractors given are in fact possible explanations besides the correct answer which can be obtained only by looking at the picture. But, over 50% of the candidates opted for distractors. Such a habit of jumping directly from observation to conclusion could be associated with the way language is being learnt. A common practice in language is to ask students to use their own imagination and expression to describe or interpret a sequence of pictures. As a result, students tend to generalize and apply such a technique, i.e. imparting their own feelings, in solving problems. Of course, such subjectivity is not encouraged in science.

2. Inappropriate experimental techniques

Students are often eager to obtain results whenever they carry out experiments. However, they seem to appreciate experimental techniques as a means of obtaining the results but do not really appreciate the interrelationship between the experimental technique and the outcome. Consequently, they often ignore the importance of such experimental techniques and encounter problems in getting the expected answer. One very obvious example is the testing of solubility of a salt in water. Students tend not to control the amount of the salt and the amount of water used as they carry out the test. Usually they prefer to work with a large amount of salt because they think that it will produce better results. They find that the salts are insoluble which may not be the true case.

Another example is to get a correct reading from a burette. Students should be aware that the reading depends on how they look at the level of the solution in the burette as well as where they place their burette. Many students are not aware of this and hence they cannot obtain the correct/accurate results.
3. Difficulty in selecting essential observation

The difficulty in selecting essential observation probably arises from the complexity of the object or phenomenon concerned. It may also be due to the improper training. But it is more likely that students just followed experimental instructions blindly without really understanding the purpose of doing that. Some evidences for the last case are:

a) When heating an aqueous solution, the condensation of water vapour on the top part of the test tube has been recorded by some students as the essential observation. Some of them even infer the existence of such liquid as an indication of the presence of water of crystallisation.

b) After adding an aqueous ammonia to an unknown solution, heating the resulting solution will definitely give an ammonia smell. However, some students describe that a pungent gas or ammonia is produced evolved as part of their observation.

How to Teach Observational Skills?

As mentioned above, observation is a very fundamental and important process skill. It is imperative that a science teacher guide her students so that they can overcome the above-mentioned difficulties and acquire the proper observational skills. But how could we help our students? The following are some useful tips for this task:

1. Distinguish clearly observation from inference

Observation and inference are two important and related process skills. However, many students cannot differentiate them. We, as science teachers, should explain and demonstrate clearly to our students the distinction between observation and inference, so that they will not confuse the two process skills.
2. Acquire appropriate laboratory techniques

In order to obtain correct/accurate observation(s), students should have acquired some essential manipulative skills. For this reason, a science teacher should train her students to proceed step by step and think logically, so that they can master appropriate manipulative skills required for doing their scientific investigations.

3. Identify the essential observation(s)

As mentioned earlier, many students have problems in selecting what is essential observation. A science teacher or a laboratory manual should therefore give clear instructions to students on what they should observe specifically, e.g. colour, shape, size, volume, texture, hotness, hardness, taste, smell or sound.

4. Train students to be more observant

Jaus (1985) has suggested a practical way to make students more observant of their living environment. Jaus asked students to observe their teacher's various aspects, such as the hair style, dress, gesture, voice, etc., and then describe what they observe. This type of observation activities can train students to become good observers, not only of their teacher, but also of almost everything around them.

5. Cultivate good habits of recording

Many students tend to use their intuitive ideas to describe what they observe. To avoid such subjectivity, a science teacher should train her students the correct habits of recording, e.g. to be objective, to use clear and correct scientific terms or vocabulary, and record all the relevant changes honestly and accurately.
6. Identify students’ mistakes

The science teacher should point out the mistakes her students have made, discuss with them their mistakes, give explanation(s) about what they have done wrongly, and demonstrate to them the correct experimental conditions, laboratory techniques or observational skills. It would be better if she could correct their mistakes on the spot, so that they can master the correct observational skills more effectively.

In principle, no matter what is stressed, the fundamental training for observational skills is to let students practise asking the following questions:

1. What can I observe?
2. Did any change occur as I observed it?
3. Does it look the same wherever I stand?
4. Why do I think the change happened?

Besides these, seeing, smelling, touching, hearing and tasting are also important. However, at the higher level, most of the observations depend more on seeing, especially for the subject chemistry, since most of the chemicals are toxic.

The questions stated above are open-ended. Question (1) requires a direct description of an object or phenomenon being observed. Question (2) relates those observations in a dynamic system with change(s) taking place, e.g. upon heating. Question (3) stresses different aspects of the object under investigation, especially when it is a big one. This is to ensure the objectivity of the observations as well as to provide a better picture, i.e. a better relationship among those pieces of observations. Questions (2) and (3) are conditional; they provide students with an opportunity to be trained to realize that observation can be changed under certain condition(s). This is very important because in general students believe that observation is 'absolute' and 'must be identical'.
Question (4) stimulates students to find out the reason for the observation. It provides the link between theory and practice. Here, we can even ask whether the observation made was correct or not, in case theory and practice do not match. A decision has therefore to be made as to whether it is necessary to take a closer look at the object/phenomenon or at the experimental condition(s).

Conclusion

The above-mentioned six teaching tips and four guiding questions are very useful for training students in observational skills. However, we strongly believe that the success of the training of observational skills lies mainly in the continuous monitoring of students' performance in such skills by the science teacher during the laboratory sessions.

References


