Indicators of Development of Process Skills

Using indicators of development of process skills

One way to identify process skills is by the actions that using each of the process skills involves. For example, if children are sorting leaves into groups based on how smooth or fuzzy they are, they are "identifying obvious differences between objects," an observation skill. These "operational" definitions of process skills are important for recognizing the skills in students' actions.

This list of questions for process skills helps you focus your observation on significant aspects of student behavior and to interpret your observations of these behaviors. The questions in this list can be used to interpret the full range of student behavior that can be found in their speech, artifacts, writing, and drawings. Observations from all these sources can be used to decide which of the questions in the lists below can be answered by "yes."

Finding where the positive answers to the questions turn into negative ones—or more realistically, where it becomes difficult to say yes or no—locates the students' development within the map. Furthermore, and importantly, this process indicates the next step, which is to consolidate the skills and ideas around the area where "yes" turns into "no." This pointer to where progress is to be made helps you determine what your teaching should focus on next.

Observing

Do the students:

1. Succeed in identifying obvious differences and similarities between objects and materials?
2. Make use of several senses in exploring objects or materials?
3. Identify differences of detail among objects or materials?
4. Identify points of similarity among objects where differences are more obvious than similarities?
5. Use their senses appropriately and extend the range of sight using a hand lens or microscope as necessary?
6. Distinguish from many observations those that are relevant to the problem in hand?

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Questioning

Do the students:

1. Readily ask a variety of questions that include investigable and noninvestigable ones?
2. Participate effectively in discussing how their questions can be answered?
3. Recognize the difference between an investigable question and one that cannot be answered by investigation?
4. Suggest how answers to questions of various kinds can be found?
5. Generally, in science, ask questions that are potentially investigable?
6. Help in turning their own questions into a form that can be tested?

Hypothesizing

Do the students:

1. Attempt to give an explanation that is consistent with evidence, even if only in terms of the presence of certain features or circumstances?
2. Attempt to explain things in terms of a relevant idea from previous experience even if they go no further than naming it?
3. Suggest a mechanism for how something is brought about, even if it would be difficult to check?
4. Show awareness that there may be more than one explanation that fits the evidence?
5. Give explanations that suggest how an observed effect or situation is brought about and that could be checked?
6. Show awareness that all explanations are tentative and never proved beyond doubt?

Predicting

Do the students:

1. Attempt to make a prediction relating to a problem even if it is based on pre-conceived ideas?
2. Make some use of evidence from experience in making a prediction?
3. Make reasonable predictions based on a possible explanation (hypothesis) without necessarily being able to make the justification explicit?
4. Explain how a prediction that is made relates to a pattern in observations?
5. Use patterns in information or observations to make justified interpolations or extrapolations?
6. Justify a prediction in terms of a pattern in the evidence or an idea that might explain it?

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Planning and Investigating

Do the students:

1. Start with a useful general approach even if details are lacking or need further thought?
2. Identify the variable that has to be changed and the things that should be kept the same for a fair test?
3. Identify what to look for or what to measure to obtain a result in an investigation?
4. Succeed in planning a fair test using a given framework of questions?
5. Compare their actual procedures after the event with what was planned?
6. Spontaneously structure their plans so that independent, dependent, and controlled variables are identified and steps taken to ensure that the results obtained are as accurate as they can reasonably be?

Interpreting

Do the students:

1. Discuss what they find in relation to their initial questions?
2. Compare their findings with their earlier predictions?
3. Notice associations between changes in one variable and another?
4. Identify patterns or trends in their observations or measurements?
5. Draw conclusions that summarize and are consistent with all the evidence that has been collected?
6. Recognize that any conclusions are tentative and may have to be changed in the light of new evidence?

Communicating

Do the students:

1. Talk freely about their activities and the ideas they have, with or without making a written record?
2. Listen to others' ideas and look at their results?
3. Use drawings, writing, models, and paintings to present their ideas and findings?
4. Use tables, graphs, and charts when these are suggested to record and organize results?
5. Regularly and spontaneously use reference books to check or supplement their investigations?
6. Choose a form for recording or presenting results that is both considered and justified in relation to the type of information and the audience?

Adapted from Wynne Harlen, *Teaching, Learning, and Assessing Science, 5–12*, 3rd ed., (London: Paul Chapman Publishing Ltd, 2000), pages 147–150.