Concept application. Test if a ripe apple will also accelerate the ripening of other fruit, and whether there is another piece of fruit which is as effective as, or even better than, an apple for facilitating quicker ripening.

The Mysteriously Rising Water

Needed. Cup, water, food colouring (optional, but easier to see), test tube and holder, and large candle or alcohol lamp.

Exploration. Nearly fill the cup with coloured water. Put a little clear water, to a depth of no more than 5 mm, in the test tube. Hold the test tube near its top with the test tube holder, put on the safety glasses, and use the candle or lamp to boil the water. Careful: Don't burn the test tube holder! Also, don't point the open end of the test tube at another person, in case hot water spurts out.

When you see plenty of steam coming from the test tube, remove it from the flame, turn it upside down, and hold it so that the open end of the test tube is under the surface of the coloured water in the cup. Watch and wait. What happens? Did you see the coloured water rise up inside the test tube? Why does it do this (i.e. what is your hypothesis)?

Concept introduction. Where practicable, test different student hypotheses. When the water in the test tube is heated, some of it changes to steam, fills the test tube, and pushes some air out of the test tube. When the test tube is then turned upside-down in the coloured water, the steam in the test tube cools down and changes back to liquid water, leaving a shortage of air (and less pressure than normal) inside the test tube. Because the normal pressure of the air in the room (atmospheric pressure) is greater than the pressure in the space inside the inverted test tube, water is pushed up inside the test tube.

Self-Assessment: A Powerful Tool

If the ultimate aim of education is to shift to the individual the responsibility for pursuing his education, then self-assessment is a very valuable strategy. But first, a word about what self-assessment is not. Self-assessment does not mean students awarding their own summative achievement ratings. Vos (Dryden & Vos, 1997) recommends an assessment system for the 21st century comprising 50% self-assessment, 30% peer-assessment, and 20% teacher or boss assessment. Using this schema, self-assessment also does not mean that, for example, a student rates his achievement in a course as 9/10, he arranges for a friend to also rate his achievement as 9/10, he receives a teacher rating of 5/10, and exits the course with an overall

achievement of (9 x 0.5) + (9 x 0.3) + (5 x 0.2) = 8.2/10, an A rating when in fact he is a C-achieving student! Let's take one example of self-assessment, identify why the strategy is such a valuable one, and then consider further ways in which it might be employed.

During the Science Enrichment Programs I conduct, upper primary and lower high school students spend much time participating in scientific demonstrations and carrying out experiments in pairs. They keep an individual, interactive journal which I collect at the end of each day and respond in overnight. To help monitor and improve classroom participation, I issue to each student and discuss, near the beginning of the program, a rubric in the form of a two-dimensional grid. Down the left-hand side are six criteria, and across the top are three column headings which represent participation ratings (*High* [5 points], *Satisfactory* [3 points], and *Needs Improvement* [1 point]). The criteria are as follows, and the bracketed description of 5-point behavior for each is also shown in the corresponding *High* performance column of the rubric: *Materials* (always brings notebook, pencil or biro, & covered footwear), *Effort* (willing to accept tasks set, apply yourself to them, & frequently volunteer for activities), *Respect for Others* (listens to others, encourages others, helps others, tolerates the shortcomings of others, displays good manners, & keeps noise level respectful), *Cooperation* (pays attention, accepts good advice and acts on it, works safely), *Journal* (entries are neat and complete), and *Communication* (shares ideas with mentor and other students, offers advice to others where necessary, participates in group discussions, & ask questions if you have them).

Near the end of the first day, each student is asked to complete the rubric by rating performance on each criterion, to sum the points and arrive at a total score, and to hand in the rubric. Sometimes I also ask each student to complete the rubric for the participation of her partner (it is important that this option is also discussed when the rubric is first issued), and at other times I leave this peer-assessment till the second day. When next we meet, I praise honest and accurate assessments and provide for opportunities to discuss rubrics with those students whose self assessment differs markedly from my observations.

Students have clear goals, in the form of desirable behaviour, and need to consider what they might do to score higher. Others have also noted the positive response of students to strategies like this, which also provide excellent practice in metacognition (Craven & Hogan, 2001; Thomas, cited in Harlen, 2001). The empowering of students in this way also builds self esteem, which is a very important component of personal growth. Black and Harrison (2001) found that such formative assessment can provide unplanned benefits for the teacher as well. For one teacher, self-assessment was the catalyst for further innovation, resulting in strategies like independent learning and group work being more than just phrases.

Self-assessment can easily be used in conjunction with tasks like project work, cooperative learning, practical reports, and homework, and these tasks also lend themselves to peer-assessment. It is interesting that students may take a peer's comments about poor spelling or messy handwriting more seriously than the same comments made by the teacher! Towns, Marden, Sauder, Stout, Long, Waxman, Kahlow, and Zielinski (2001) have even used electronic communication to imitate a professional discourse community at the tertiary level by having student work reviewed by students and staff at distant institutions. They remind us of the strong link between writing and learning, and how revising their work requires students to think critically about both their writing and the subject matter.

Self-assessment begins with identifying suitable criteria, and students may also be beneficially engaged in this process. One could also provide descriptions in all cells of the rubric, and even weight criteria. When used for assessing participation, the strategy should not be overused to the extent that students become desensitised to it. In a classroom setting, it might therefore be employed during a few short periods of time only of a semester. Extending the concept, Borba and Olvera (2001) report the improved outcomes from parent-teacher meetings since moving to student-led conferences, based on each student's portfolio. Students were empowered by the process of discussing their strengths, weaknesses, goals, and progress.

Peter Eastwell

References

Black, P., & Harrison, C. (2001). Self- and peer-assessment and taking responsibility: The science student's role in formative assessment. *School Science Review*, *83*(302), 43-49.

Borba, J. A., & Olvera, C. M. (2001). Student-led parent-teacher conferences. *The Clearing House*, *74*, 333-336.

Craven, J. A. III, & Hogan, T. (2001). Assessing student participation in the classroom. *Science Scope*, *25*(1), 26-40.

Dryden, G., & Vos, J. (1997). *The learning revolution (Your 21st century passport: For families, students, teachers, managers, trainers)*. Auckland: The Learning Web Ltd.

Harlen, W. (2001). Research in primary science education. *Journal of Biological Education*, *35*, 61-65.

Towns, M. H., Marden, K., Sauder, D., Stout, R., Long, G., Waxman, M., Kahlow, M., &Zielinski, T. (2001). Interinstitutional peer review on the internet: Crossing boundaries – electronically – in a student-refereed assignment. *Journal of College Science Teaching*, *XXX*, 256-260.

Students' Alternative Conceptions

Students' alternative conceptions have been variously called misconceptions, prior conceptions, preconceptions, preinstructional beliefs, alternative frameworks, naive theories, intuitive ideas, untutored beliefs, and children's science. The tasks in this regular section of *SER* are based on the literature and may be used at the beginning of a constructivist learning segment to arouse the curiosity of students and to motivate them, while simultaneously eliciting their ideas or beliefs. They are designed to address areas about which students are likely to have an opinion, based