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Assessment of Primary Students' Science Concepts And Attitudes Through Drawings

Joseph P. Riley, Toh Kok Aun and Wan Yoke Kum

Introduction

Experienced teachers, enrolled in the advanced diploma primary science program, conducted classroom action research projects in collaboration with NIE faculty. Working in teams and individually the teachers employed student drawings in assessing both conceptual and affective student outcomes.

Rationale

Science Educators are examining young children's drawings to learn more about how they view the world. The ability to assess students' existing knowledge about science concepts is a critical component in the constructivist approach to science teaching. It is the initial step in planning science lesson that will build on students existing knowledge. Students' science drawings can provide insight into the learner's "private universe."

Prior research confirms that young children come to science classrooms with well established preconceived ideas about science concepts. These preconceived ideas are firmly entrenched because they are often based on life experiences. These preconceptions allow children to construct explanations for observed everyday phenomena. Each child puts together shared and unique explanations that together make up their own private universe. The child's private view of how the world works, built on common sense understandings often resists even the most talented science teachers efforts to change them.

Advocates of a constructivist approach to science teaching feel that teachers need to understand their students' naive or pre-constructed views of science phenomena in order to better design learning experiences that will encourage conceptual change. They believe that teachers must know what the student is thinking if instruction is to alter or build on it. This research hopes to assist teachers by documenting students' science misconceptions and providing informed starting points for instruction. Working in teams, and as individuals, teacher/researchers collected student drawings and analyzed them to get snapshots of students' concept development as well as indicators of students' science attitudes.

Students' Conceptions of Plants

Mariam bte Ismail, a teacher in Jing Shan Primary school collected and analyzed 60 pictures of plants drawn by ten year old pupils. The research developed out of her concern that because Singapore has such a highly urbanized environment, children might not have first-hand life science experiences. Although Singapore is regarded as a garden city with more than half a million trees lining its roads, many children grow up in high rise building with little space for plant cultivation. As part of an ongoing broader research study involving tests on plant classifications, naming of plants and student interviews, students were asked to draw a picture of a plant.

Students' Perceptions of Scientists

Another team of teacher/researchers comprised of Pok Sat Yoong (St. Hilda's School), Eng Sim Choo Magdalene (West Grove Primary School), and Suraya bte Mohammed Iqbal (Sembawang Primary School) were interested in students' perceptions of scientists. Prior research indicates that many primary school students hold generally negative stereotypic views of scientists often describing them as, working alone, having a limited social life, uninterested in other people and having few interests. These perceptions can influence student attitudes toward science (Schibeci, 1986; Schibeci & Riley, 1986). Singapore is positioning itself to be at the forefront of science and technology research and is actively promoting science as a career path for students. Because of this, the teacher/researchers wanted to assess Singapore students' perceptions of scientists. Prior research indicates that not all cultural groups hold similar stereotypic views of scientists (Finson, 2003). The research also looked for variations in perceptions among Singapore's three major ethnic groups.

Data Collection

Both studies made use of student drawings for data collection and analysis. Draw-A-Plant and Draw-a-Scientist tests have been used extensively in science education and have published protocols and data analysis procedures (Finson, 2002). Published reliability scores for the Draw-a-Scientist Test (DARST-C) are in the $r = .80$ and higher range (Finson, Beaver, & Cramond, 1995).

Results (draw a plant)

Preliminary analysis of results of participating subjects' drawings indicate that Singapore students do have clear conceptions of plants. 100% of the student drawings indicated leaves and stems while 67% included roots. Flowers on herbaceous plants were drawn by 74% of the pupils. Trees were drawn by 18% of the students. Follow up questions regarding plant drawings in a similar study involving American students found that a large percentage of students tended to reserve the word plant for small herbaceous plants and consider trees in a class of their own, something other than plants (Tull, 1992; McNair & Stein, 2001). The same was true in Singapore but to a lesser extent. Student drawing of plants without roots require follow up questions to determine if the omission was because they cannot be seen or if they are not thought of as part of a plant. More than a third of the students consider mushrooms and bracket fungus plants.

Results (Draw-a Scientist)

Primary five students from four different schools in the Eastern, Central and Western regions of Singapore participated in the study. Participants were given a blank piece of paper and asked to draw a scientist. This resulted in a pool of over 500 student drawings. The drawings were separated by ethnic group and then 50 were randomly drawn from each group (Chinese, Malay and Indian). Prior research in other countries predicted that an overwhelming amount of boys would draw the figure of a male scientist, and results here confirmed this to be true in Singapore. Ninety-six percent of the boys drew a male scientist. While there was some slight variation across ethnic groups for boys drawing males, there were no significant differences among them. Seventy percent of the primary five girls also drew male scientists. Again there was variation across races but no significant difference was detected, with a composition comprising of 32% Chinese, 29% Malay and 28% Indian. Preliminary results showed that not all ethnic groups pictured scientists in the same way. Chinese students were more likely to draw scientists with some indicators of danger in the picture (for example exploding test tubes). These indicators of danger were included in 55% of Chinese student drawings compared to 22% for Malay and 9% for Indian students.

Implications

Both studies contribute new knowledge about Singapore primary school students' understanding of basic science knowledge and attitudes. Sampled students' understandings about plants compare favourably with results of the same

age students on similar tests in other countries. The misconceptions about plants should help teachers in planning their instruction.

Results of the Draw-A-Scientist indicate that primary five students may view science as a male domain and hold stereotyped views of scientists. A high percentage of primary five girls hold these same limiting views. The findings suggest that primary school students need more opportunities to see either in primary science textbooks or in life real, scientists especially women scientists. Without true life role models of men and women in science, the comic-book caricatures of scientists held by primary grade students may deter them from developing early interest in a science career. The research also validates the use of student drawings as a viable instructional and research tool and classroom teachers as valuable contributors to educational research

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