features

Student images of scientists: What are they? Do they matter?

by Renato Schibeci

What images do students (including student teachers) have of scientists? Are they stereotyped images? Is it reasonable to expect students to have images of scientists that are in accord with current scientific practice? Scientists and science teachers have long been interested in student images of scientists. This paper summarises some of the research on images of scientists that have used the Draw-A-Scientist Test, and other related procedures. Secondly, it reviews the importance of images of scientists for science classrooms and includes some sample strategies for countering prevailing stereotypes.

'Stereotypes shrivel our humanity.’ (Christians, 2003, p. 251) ‘draw a headache' procedure: 226 children were asked to draw their headache, and medical doctors found that the drawings were remarkably ‘dramatic and insightful’ in predicting migraine (Anonymous, 2002).

In my view, drawings have a place among the tools science teachers use to probe student images.

First, I will consider the place of drawings in other education contexts.

Anning (1997), writing of the place of drawing in Design and Technology and Art in the UK, noted:

In asking children to draw in educational contexts we derive practices from this diversity of socio-cultural and artistic traditions. However, many teachers are only vaguely aware of the complexity of these traditions. For them drawing is a minor mode of communication, certainly secondary to writing and speech, in education. They are unaware of the power of graphicity as a tool for learning and for recording thinking in classrooms. They are also uncertain about the appropriateness of genres of drawing for different purposes and therefore unable to give clear guidance to pupils. Indeed in many classrooms drawing is more likely to be caught than taught. (p. 219)

If this is the case, what happens when students are asked to ‘draw a scientist?’
Although drawing itself is a potentially powerful way of eliciting students’ thinking, in the context of a classroom request, students may simply fill in time by drawing the first thing that pops into their heads. As Anning (1997) argued:

The messages children absorb from primary school pedagogy are that drawing is about representation of real objects (‘draw that bunch of daffodils’); a time filler to keep them harmlessly occupied (‘when you’ve finished your work do a picture’); or at best an opportunity to describe remembered or imagined narrative in graphic form (‘draw the animal you liked best in the urban farm’ or ‘draw an amazing monster’). They learn that getting better at drawing is a self-help zone and that it is not valued as a tool for clarifying their thinking or recording their ideas. The teacher will only pay cursory attention to their drawings however much effort they put into them. (p. 226)

We must bear these suggestions in mind as we consider the usefulness of the drawing as a probe of student images.

**Draw-A-Scientist Test**

The Draw-A-Scientist Test, as developed by Chambers (1983), invites students to draw a scientist. The drawings are then analysed for the presence of the following seven ‘indicators’: (1) laboratory coat; (2) eyeglasses; (3) facial hair; (4) symbols of research; (5) symbols of knowledge; (6) signs of technology; and, (7) captions. Many science educators have been attracted to the simplicity of the procedure, and numerous studies followed the publication of Chambers’ work.

**School students: Western cultures**

Early studies (Chambers, 1983; Schibeci & Sorensen, 1983) that used this procedure revealed two common patterns:

- The average number of indicators per drawing increased with increasing grade level.
- The overwhelming majority of drawings were of male scientists.

Some later studies have suggested children acquire stereotypical images at the age of six or seven (Matthews and Davies, 1999; Newton and Newton, 1992).

Have the images of students in Western cultures changed since DAST was first used? The research is not conclusive on this question. Matthews and Davies (1999), for example, reported that (compared with their 1993 results), ‘secondary pupils are drawing more stereotypical pictures than before’ (p. 84). Barman (1997), who invited readers of the US publication for primary teachers, *Science and Children*, to investigate student images concluded that there had been a number of changes over the years. He wrote that the majority of students depicted scientists as ‘realistic people’. Also, indicators of ‘secrecy’ and ‘danger’ appeared less often than in the past. Nevertheless, he noted a confirmation of many stereotypes: scientists were usually white males with facial hair, glasses, lab coats and who worked indoors. A follow up study (Barman, 1999) with high school students confirmed the trend to more ‘everyday’ people—rather than fictional characters—being depicted.

**Images in various cultures**

What do investigations of student images in a variety of cultures show? Studies in Brazil (Lannes, Flavoni and De Meis, 1998), Bulgaria (Petkova & Boyadjieva, 1994), Korea (She, 1998) and Cyprus (Hadjikyriacou, 1998) all suggested that the images of scientists were not significantly different from images reported elsewhere.

In contrast, Manabu (2002) reported that children in China, Indonesia, Korea, the Philippines and Japan showed amalgams of indigenous science and Western modern science. This is the first study in which explicit non-Western images could be found.

**Images of teacher education students**

DAST has been used to probe the images of teacher education students as well as school students (McDuffie, 2001; Matkins, 1996; Rahm & Charbonneau, 1997; Rosenthal (1993). These studies generally confirm the prevalence of the scientist stereotype. Indeed, researchers have written: ‘Not only do stereotypical images of scientists exist, they are also pervasive and extremely resilient’ (Rahm & Charbonneau, 1997, p.777) and ‘The persistence of the stereotype of scientists’ is extraordinary’ (McDuffie, 2001, p.17).

The images of Hebrew-speaking and Arabic-speaking students have been reported by Rubin and Cohen (2003). The stereotypes reported in other studies were generally true for the Israeli-speaking students in the sample. The Arabic-speaking students, on the other hand, showed a preference for ‘classical Islamic scientists’, which, the authors suggested, reflected ‘a general trend in the Arab world of promoting awareness of Arabic culture’ (p. 840). This is the second study (the first was Manabu (2002) above) in which explicit non-Western images appear.

**A popular probe of images**

These many studies show the popularity of DAST, or some variation of it, as a procedure for probing student images of scientists. These studies confirm the existence and ubiquity of stereotypes, particularly in Western cultures. Two studies (Manabu, 2002; Rubin & Cohen, 2003) in non-Western cultures are beginning to report non-traditional images.

DAST clearly has the advantage of being easy to administer, although scoring (if a quantitative measure is a goal) is problematic. For science educators interested in probing student images, it is worth examining alternatives to DAST that have been developed.

**Alternatives to DAST**

The basic assumptions underlying the DAST procedure have been questioned by some researchers. Symington and Spurling (1990), for example, claim the DAST measures knowledge of public stereotypes of scientists and not necessarily what individual students know about what scientists do. Matthews (1996) cautioned that the drawings do not tell us everything about the pupils’ view; they can only give a ‘very rough indication’ (p. 242). Some investigators have therefore developed alternative approaches to remedy the perceived deficiencies of DAST.

The main alternative approach has been the interview. Palmer (1997), for example, developed an approach he called ‘Relevance of Scientists Approach’ (ROSA). Students were asked, ‘Can scientists do anything about endangered species?’ He interviewed 67 Year Six and 58 Year Ten students in Newcastle, Australia. According to the
author, 'ROSA is a comparatively simple technique, yet it enabled a rich variety of responses to be elicited from the students' (p. 180). He concluded that his results demonstrated students' images that differed from stereotypes reported in earlier studies.

Rampal (1992) investigated the images of 199 teachers in India via a written questionnaire; she reported that the teachers tend to view scientists as 'unfamiliar yet extraordinary beings ... who display a keen sense of commitment and patience in their pursuit for 'truth' (p. 432).

An interesting study by Parsons (1997) involved interviews with 20 'homogeneous, academically competent, black female' students. These students' images of scientists had some common traits. For example, both the black scientist and the white scientist was viewed as a 'hard-working, dedicated and intelligent person who prefers to be left alone' (p. 761). However, there were differences as well:

Just as the scientist as a white person was characterised as non-emotional and rational, the black scientist is described as kind, respectful and easy-going, traits that are consistent with being responsive and sensitive to the emotions of others.' (p. 761)

character. They reported: 'in general, scientists are not perceived by children to be villainous or undesirable models, but are seen as good characters' (p. 296) and that 'boys evaluated scientists more positively than girls' (p. 297).

Boylan, Hill and Wallace (1992) adopted the Interviews-About-Instances procedure (White and Gunstone, 1992) to probe primary and secondary student images in Penang, Malaysia. Students from primary and secondary schools were invited to examine paired drawings and then asked to choose which was the more likely to depict a scientist or a scientific work area. Examples of paired drawings included:

- 'Caucasian male in lab coat'/'Caucasian female in lab coat';
- 'female, simply dressed with lab coat'/'stylish female with lab coat';
- 'library/traditional school laboratory'; and,
- 'writing a report/entering data on a computer'.

Responses from 121 students led the authors to conclude that, in general, 'students were able to distinguish between what the present situation is (i.e. more male scientists ... and what is possible' (p. 474). Even though they thought that males were more likely to be involved in science, they saw no

importance of student images of scientists for science classrooms

What are the implications of all this for science teachers? Perhaps we can answer this by posing two specific questions:

- Are student images of science and scientists important?
- If they are, how do we ascertain what they are?

Are student images of science and scientists important?

One answer is that they are not important in themselves, but they do provide important clues about student views of the nature of science. Schibeci and Lee (2003), writing of stereotyped images, noted:

Does it matter if students (or adults, for that matter) constantly meet stereotyped images of scientists? After all, stereotypes can help us to identify quickly a character in a play or film. In fact, Michael Crichton ..., known for the book and film, Jurassic Park, told a meeting of the American Association for the Advancement of Science (AAAS) that it does not matter. In the context of movies, stereotyped portrayals of scientists were a requirement of the medium, and scientists should stop their 'self-flagellation' when they saw negative stereotypes. (p. 188)

However, an unvarying diet of stereotypical scientists is not likely to be conducive to the formation of realistic images of science and scientists, as the earlier review of media research indicated. For those in the science education community who wish to encourage students to consider careers in science, such stereotypes may contribute negatively to such choices, especially among girls (see, for example, Bandura, Barbaraneli, Caprara & Pastorelli, 2001). More cogently, Petkova and Boyadjieva (1994) have argued: 'investigating the image of the scientist is not merely an act of pure curiosity: it is important both for understanding scientific activity and for public understanding of science' (p. 215). Given the increasing need for 'technological citizenship' in which ordinary citizens are required to make decisions that have a science/technology dimension, it is important for science educators to understand
students' current thinking, including their images of science and scientists.

If student images of science and scientists are important, how do we ascertain what they are?

Clearly, DAST, judging from its popularity among science educators, is one contender as a primary research tool for ascertaining student images. It has been specifically used to evaluate the extent to which intervention programs change students' stereotypes. A study by Mason, Kahle and Gardner (1991) suggested that an intervention program resulted in more female scientists being drawn; however, they noted that 'the experimental group did not include a significantly lower number of standard indicators on the DAST' (p. 195). Another study by Mays (n. d.) concluded: 'student stereotypes concerning scientists can be altered'. This conclusion was based on the finding that in the pre-test, all the African-American female students drew a white male Caucasian scientist, but on the post-test, half of these same students drew African-American female scientists. However, all the African-American male students continued to draw white male scientists.

DAST is popular as a device for teachers to use to explore their students' images; there are numerous examples that can be found on the web. The website, http://www.sjsu.edu/depts/it/editqry/s6/mod6.html, asks learners to, Draw a scientist. Make a drawing of a scientist. Teachers are then invited to:

- Examine students drawings. Assign one point for each characteristic.
- Remember, the higher the score, the higher the negative stereotype of a scientist. The lower the score, the less stereotypical the image.

Eleven stereotypical indicators are provided: lab coat, eyeglasses, facial hair, symbols of research - test tubes, flask; symbols of knowledge - books, filing cabinet; signs of technology - solutions, machines; captions - Eureka, I've got it!!!; male; signs labeling - Fire, Danger, Poison; pencils and pens in pocket protector; and - unkempt appearance.

One implication is that DAST alone, as a decontextualised request to students, is unlikely to provide valid views about student images. Science educators need to consider carefully the context in which their probes are used. The following questions to be considered:

- When asked to 'Draw a Scientist', does the student ask 'How can I make what I draw immediately recognisable to the person asking me to draw a scientist'?
- How does the student differentiate a scientist from other workers in terms of appearance?
- What exposure have students had to scientists? For the student, is a medical doctor a scientist? Is a nurse a scientist? A marine biologist?
- Does drawing a scientist provide a valid indication of students' conceptions of 'doing science'? If not, how do we investigate such conceptions?

We must help students how to judge the realism of the fiction they see daily. DAST has a role in such a process: as an initial probe, followed perhaps by an interview or an invitation to describe why they drew what they did, which may be useful as a research tool. DAST alone is not a sufficiently sophisticated research procedure. Many science educators agree. They have also viewed DAST as limited, and have developed alternative procedures, described above. These alternative procedures have greater potential to elicit student images than DAST alone.

References


Box 1. Sample strategies for countering stereotypes of scientists

Strategy 1: Study the work of Australian scientists
If you asked your students to name a scientist, whom would your students nominate? Einstein? To help them appreciate the work of Australian scientists, especially women scientists, use the resource:


Strategy 2: Science case studies
Give your students an opportunity to examine an actual case study of science in practice. There are many such cases. One, suitable for secondary students, is the development of the model for the DNA molecule. This is a story rich in the detail of scientific practice that illustrates the human dimension of science. The famous paper by James Watson and Francis Crick which opened with the sentence, “This structure has novel features which are of considerable biological interest” began a revolution in life sciences. The paper, however, gives no inkling of the human struggles which led to this and subsequent papers; nor does it give adequate recognition to the work of Rosalind Franklin. These struggles are well documented in sources such as:

- One teacher’s approach: http://www.brown.edu/Courses/BIO020-Miller/dn/index.html
- Some background from the Nature journal: http://www.nature.com/nature/animals/index.html
- The dramatization of the story in the film, Life story (http://www.imdb.com/title/tt0093815/)
- One of the key figures was Rosalind Franklin, about whom the two biographies will be helpful:

These are a small selection only of the available sources on the DNA story. There are other stories which equally can be used to help students understand science in practice.

Strategy 3: Meet a scientist
Some organisations provide the opportunity for articulate, well-presented scientists to talk to school students. Make the most of such opportunities, as it is likely the majority of students will not have met an actual scientist; rather, they come to rely on stereotypical scientists in popular culture.

ASTA has a SCIPS project (http://www.scips-asta.edu.au/home) that could meet this need:

  The overall objective of the ASTA School Community Industry partnership in science (SCIPS) Project was for schools, students, teachers, community and local government, industry and/or business people to work in partnership to design and implement a small innovative science-based project that promoted scientific literacy in their community

The Australian School Innovation in Science, Technology and Mathematics (ASSISTM) Project (http://www.assistm.edu.au/), will have other examples of scientists/ schools/ community partnerships.

Other examples include the learning objects available at The Learning Federation’s website: http://www.thelearningfederation.edu.au/llf/showMe.asp?nodeID=574 which are designed to provide opportunities for students to develop a broad understanding of the science profession and as scientists as people.

The Australian Museum has a similar ‘meet the scientist’ link: http://www.amoqua.net.au/ands/news/scientists.html

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