



Multicultural Students' Perceptions of Scientists and Science

Mary C. Kelly

Irish College of Humanities and Applied Sciences

Abstract

This session explores international school students' perceptions of scientists and science, prior to and following an intervention program. The study aimed to examine the perceptions of scientists and science held by the students, and to establish the extent to which these images were open to change. Middle school students from different countries, within an international school environment, were asked to draw a scientist and to describe a day in the life of a scientist. The drawings were based on the original Draw-a-Scientist-Test developed by David Chambers [1]. Descriptions of the daily lives of scientists were added to the drawing, as studies indicate that images alone do not fully capture students' conceptions of science and scientists [2]. Following the preliminary data collection, students were exposed to the daily activities of local scientists from various cultures, races, and backgrounds, over a five-month period. This session provides a description of the initial data collection stage, the intervention steps, and the analysis of the data following the intervention. The study makes recommendations for curricular change, access to diverse role models, the explicit valuing of women's contributions to science, and the reevaluation of teaching resources, including a critical examination of the media sources used in teaching.

Introduction

In recent decades, there has been significant interest shown in the perceptions of scientists and science held by students of all ages [3], given that stereotypical perceptions influence students' capacity to see themselves in science related careers [4]. Stereotypical images are influenced by culture, gender, and socio-economic status [5] and widespread images of scientists as Caucasian males are proving problematic. Despite attempts to influence this view of scientists, the trend has continued over several decades [6], although there is evidence emerging of a shift in perspectives, following a meta-analysis of 50 years of students drawing scientists [7]. The study indicates that more girls are drawing female scientists, than in previous decades, and a more diverse range of scientists are appearing in the drawings. However, as girls grow older there is still a tendency for them to view science as a male dominated field, even though there has been a steady increase in the number of women in science.

Background

Multicultural students' perceptions of science and scientists were explored in an international school in South East Asia, which serves around 350 students from 30 different countries. Teachers are predominantly Caucasian American, with a few teachers originating from South East Asia, Europe and Australia. To begin with, images of scientists were drawn by all students from Kindergarten to Grade 12 using the Draw-a Scientist-Test. These drawings indicated that all of the boys and the majority of the girls drew Caucasian male scientists, working mainly in laboratories. I wondered whether these images emerged because teachers were legitimising a Western view of science, despite the fact that inequitable science education has been identified as one of the causes of cultural underrepresentation in science [8]. Research indicates that a failure to address this issue could directly influence students' higher education opportunities and their future careers [9]. Therefore, the question arose as to whether intervention steps could act to dispel the stereotypical images of scientists that had developed for the students. In order to determine if this were the case, I developed a comprehensive intervention program for a class of Grade 7 students (aged 12-13), which was composed of 24 students, 12 boys, and 12 girls, from different cultural backgrounds.

Research Approach

Stage 1 of the project involved exposing the existing perceptions using Draw-a Scientist Tests, interviews, written paragraphs, and questionnaires. Stage 2 involved the intervention program designed to provide the students with a more equitable exposure to science. Stage 3 involved an evaluation of the effect of the intervention program using the same evaluation procedures as were used in Stage 1.



Intervention Program

The intervention program began with the research of female and multicultural scientists, and the creation of résumés for a range of scientists. Next step was to invite multicultural individuals from STEM related careers into the classroom to work with the students on activities. Students had the opportunity to ask them questions and to learn about their lives while carrying out the activities. After these visits, we looked at the lives of additional scientists through mainstream movies that profiled female and non-Caucasian scientists. Additionally, students presented research projects to other grade levels on topics inspired by the scientists' visits, such as projects on environmental issues following a visit by two EPA scientists from Ireland. To follow up, and to highlight the fact that scientists work in different locations, the students spent time outside on a multi-disciplinary garden project, which was guided by the expertise of two local horticulturalists.

Results

Initial quantitative data, prior to intervention, indicated that the majority of the students drew Caucasian males, working in laboratories, wearing white lab coats, and glasses. There were a few female scientists drawn only by female students. Following the intervention program, there was a 33 percent decrease in the number of males drawn, a 16 percent decrease in the number of Caucasians, a 45 percent decrease in the number of scientists wearing glasses, and a 17 percent decrease in the number of scientists situated in laboratories. On an individual level, 67 percent of the students showed a decrease in standard DAST indicators, with a number of students drawing and describing scientists from other cultures, and a number of boys drawing female scientists. Students had more difficulty when drawing their follow up images, as they said that they had many ideas, and found it difficult to choose one single image of a scientist. Initial qualitative data including interviews and written passages indicated that most scientists were chemists, who worked hard, and exhibited limited personality traits, and students were able to name just a few scientists, mostly Caucasian. In the post interviews, students identified a greater range of scientists, who had a broader range of personalities, and they were able to name several scientists, across genders and cultures. Interestingly, during the interviews and in the written passages, few students expressed an interest in becoming scientists, either before or after the intervention program.

Composite Views of Scientists

A synthesis of the data yielded two composite descriptions of scientists, and the differences between the profiles suggests that the images that students had were open to positive change.

Pre Intervention

The scientist is a youngish Caucasian male who works in a relatively safe laboratory. He appears to be a chemist, uses a limited range of equipment, and usually wears glasses and a lab coat. He is hard-working, and intelligent, and caring, and he loves his work. He could be married or single, or may or may not have children. He has few outside interests as he works long hours.

Post Intervention

The scientist is a youngish man or woman of various origins who works either in a safe laboratory or outside. They are different kinds of scientists, they use a wide range of equipment, they usually wear a lab coat, and may or may not wear glasses. They are intelligent, determined, and caring, and they love their job. They could be married or single, and may or may not have children. They earn a good living, they work long hours, and have other interests outside of their work.

Discussion

The study has positively influenced the number of female students drawing female scientists, and this is encouraging as gender stereotyping causes female students' to avoid science related careers. The ethnicity of the scientists changed moderately, although not to the degree that I had anticipated. When asked afterwards as the why they may have drawn Caucasian scientists the multicultural students, who drew Caucasians, felt that it may have to do with being taught by Caucasian science teachers and through Western textbooks. Indeed, they make a good point, as by far the majority of international school



science teachers are Caucasian and the textbooks depict Western images, and this combination may be causing students to internalize negative stereotypical images [10].

As a whole, students' found science to be interesting, and although the level of interest rose from 17 percent to 46 percent following the program, this did not influence their interest in science as a career, a point that has arisen in other studies [11]. In part, this may be due to the fact that students describe scientists as hardworking people who work long hours. Indeed, many mainstream movies depicting scientists emphasise this view. However, research indicates that an increasing number of movies and shows, such as CSI, Bones, and Hidden Figures, profile female and multicultural scientists as ordinary people having regular lives, and these depictions are beginning to positively influence perceptions [12].

Conclusion

In general, the international students believed that they developed stereotypical images of scientists, due to a lack of diversity among their science teachers, and due to the influence of media that promote stereotypical images of scientists. It is clear that change is needed in international school contexts concerning how science is presented to students. This is especially the case with younger female students and students from across different cultures, if all students are to have the opportunity to imagine a future in science. Even though stereotypical views on science and scientists proved open to change, among middle school students, intervention may be needed at an earlier stage in order to positively influence students' perceptions of science as a career choice.

Recommendations

To counteract stereotypical views of science and scientists, students in international schools need access to science teachers that represent different genders and cultures. In addition, they need to engage with a wide range of professional scientists whilst carrying out real-world investigations and activities [13]. Moreover, when designing curricula and choosing resources, it is important for teachers to dispel the myth that science has resulted solely from the accomplishments of Caucasian males. Culturally responsive curricula needs to address inaccuracies, omissions, and distortions. In addition, a critical examination of textbooks, mainstream movies, cartoons, and other media is crucial, especially those that cling to negative stereotypical views of science and scientists.

References

- [1] Chambers, D. W. "Stereotypic images of the scientist: The draw-a-scientist test." *Science Education*, 67, 255-265, 1983
- [2] Emvalotis, A., and A. Koutsianou "Greek Primary School Students' Images of Scientists and Their Work: Has Anything Changed?" *Research in Science and Technological Education*. 36,(1), Routledge: 69–85, 2018
- [3] Steinke, J., Lapinski, M.K., Crocker, N., Zietsman-Thomas, A., Williams, Y., Evergreen, S.H., & Kuchibhotla, S. "Assessing media influences on middle school-aged children's perceptions of women in science using the Draw-A-Scientist Test (DAST)." *Science Communication*, 29, 35-64, 2007
- [4] Osborne, J. (2003). "Attitudes towards Science: A Review of the Literature and Its Implications." *International Journal of Science Education*, 25, 1049-1079.
- [5] F. McCann, F. and Marek, E. "Achieving Diversity in STEM: The Role of Drawing-Based Instruments." *Creative Education*, 7, 2293-2304, 2016
- [6] Scantlebury, K., Tali, T., & Rahm, J. FORUM: "That Don't Look Like Me. Stereotypic Images of Science: Where Do They Come from and What Can We Do with Them?" *Cultural Studies of Science Education*, 1, 545-558, 2007



[7] Miller, D. I., Nolla, K. M., Eagly, A. H., & Uttal, D. H. "The Development of Children's Gender-Science Stereotypes: A Meta-analysis of 5 Decades of U.S. Draw-A-Scientist Studies." *Child Development*, 89(6), 1943-1955, 2018

[8] Bryant, N. "Introduction. Science for all cultures: A collection of articles from NSTA's journals." National Science Teachers Association. Arlington, Virginia, 1992

[9] Hampton, E. & Licona, M. "An Emerging Understanding of Science Literacy: Moving towards a curriculum of inclusion". *Electronic Journal in Science Literature Education*. 1(1). Summer. 2001, Online address: <http://sweenyhall.sjsu.edu/ejIts>

[10] Adams, M. "Readings for Diversity and Social Justice." New York, NY: Routledge, 2000

[11] DeWitt, J., & Archer, L. "Who Aspires to a Science Career? A comparison of survey responses from primary and secondary school students." *International Journal of Science Education*, 37(13), 2170-2192, 2015

[12] Jones, R., & Bangert, A. "The CSI Effect Changing the Face of Science". *Science Scope*, 30, 38-42, 2006

[13] Bodzin, A. & Gehringer, M. "Breaking science stereotypes: Can meeting actual scientists change students' perceptions of scientists?" *Science & Children*, 38, 24-27. 2001