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Revisiting research on factors influencing science career choice

Robert B. Flegg[1]

[1]Retired Science Educator and Senior Editor of UNET*JoSS*

1. ABSTRACT

In recent days there has been a growing interest in attracting young people into careers in science, technology, engineering and mathematics (STEM). It seems timely to revisit the author's 1992-1997 research titled: *The science career decision: a model describing the career orientation and decision-making processes of science-track students*. In the thirty years since this investigation was undertaken there have been many scientific and social changes. It is instructive to briefly examine some more recent research findings to identify changing trends in science-track decision making. The primary changes were found to be progress in early childhood science education, the limited availability of jobs and a general decline in the public perception of science.

2. INTRODUCTION

In 1992 the author commenced PhD research through Queensland University of Technology in Brisbane[1]. At the time the researcher was a science teacher and later department head at a private college on the Redcliffe Peninsula in Southeast Queensland. Between 1992 and 1997 an intensive qualitative study was conducted to ascertain the factors influencing secondary students moving into tertiary studies with a view to a career in a scientific field. The outcome of the study was a grounded theory that described how the science-track decision is a developmental and refining process that takes place over many years.

> From early childhood young people begin to build up a profusion of interests, preferences, attitudes, and images relating to the world of work. With the passage of time and through shifting contexts, these cognitive and affective fragments are fashioned and refined into an image of self in a career.[1]

The forces which forge and tweak this self-image are rooted in the values of the individual and through close study over several years the researcher was able to draw out the primary influences in this process.

The first is **developmental experiences**. Children often develop idealistic, even fanciful images of themselves in particular roles and these may be intense and retained into adult life. Consequently, a visit to the zoo, seeing a scientist in a cartoon or undertaking a simple hands-on science experiment could become a pivotal point in establishing an image of self in a scientific profession. This highlighted the importance of experiencing natural phenomena and practical problem solving during the years of early-childhood education.

Secondly, **significant people** in the lives of children help fashion their self-image with regard to a career. A parent or relative with an interest in science or technology can be a decisive influence. Even a few words spoken such as "you'd make a good biologist one day" can be identified as a critical turning point in career decision making.

Third, young people's **perceptions of science** played an important role in directing the career path. Certainly for science-track students science was perceived as involving hands-on, fun activities. Viewing science as a helping activity tended to bolster the appeal for some. It could alternatively be seen as an isolating career, working in gloves and white coats in a laboratory with limited human contact.

Finally, the investigation revealed a variety of **social, economic and personal filters** that could be applied. This would effectively rule out occupations deemed to be less desirable.

Over the thirty years since that research there have been an enormous number of scientific, technological and societal changes. Very recently questions have been raised publicly about the state of STEM gender equity in Australia[2]. Consequently, it will be instructive to review some of the key research on science career choice over that period.

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3. DEVELOPMENTAL EXPERIENCES

Many recent studies such as Vartiainen & Kumpulainen[3] in 2020 have highlighted the importance of science play in forming a child's image of science. This is achieved through imagining, roleplay and problem solving often involving hands-on activities with science objects.

Other studies such as Rhodes, Cardarelli & Leslie[4] from 2020 have suggested that educators need to change the language they use in early science education. Terms such as 'doing science' are to be preferred over 'being a scientist'. The aim is to make children more aware of the scientific method and less likely to have a stereotypical image of a scientist. This represents a shift in approach over the last few decades and could have some effect on the development of career self-concept if widely implemented.

As young people grow through their school years they develop a certain amount of 'science capital'. This term was coined by Archer[5] in 2015 and is used

> … to describe a number of factors correlated with expressions of interest towards science careers in young people, including science-related attitudes, values and dispositions, knowledge about the transferability of science, talking about science in everyday life, and knowing people in science-related jobs. Young people with high levels of science capital are more likely to express a desire for a future science career.[6]

An internet search reveals a plethora of websites and businesses dedicated to early childhood science experiences. The research thirty years ago found that such experiences were incidental, often linked to parental activities. It is gratifying to see that currently science engagement is being picked up and implemented by educators as an important precursor to the STEM career path.

4. SIGNIFICANT PEOPLE

A brief review of literature concerning the science track still indicated that parents, family members and teachers play an important role in directing young people into STEM careers.

A useful summary comes from a 2010 symposium presentation by Jon Miller of Michigan State University[7] in which he presented longitudinal research findings from a study of 6000 students showing that parental influence and access to mathematics are the key influences guiding students into science, technology, engineering, mathematics and medicine (STEMM) careers.

It would appear that little has changed in this area since the nineties. Some further insights have been obtained. There is a small gender bias apparent with boys more likely to be encouraged down the science track. A small but not insignificant link was found between parents' level of education and entry into STEMM courses at university.

If parents are still the prime motivators, this is probably an area to be addressed by the science and educational communities. Research commissioned by the U.S. Department of Education[8] surveying more than 1400 parents indicated that most felt inadequate to 'do science' or answer children's scientific questions. They were much more more confident about their capacity to help develop literacy and numeracy skills in their children. Many said they would be appreciative of help in the science area. This may be an indication that science is perceived as too difficult by a large proportion of the adult community. More fundamentally, the concept of problem-solving as a lifelong skill is the message that needs to be widely communicated.

5. PERCEPTION OF SCIENCE

There is quite a deal of literature discussing the changing public perception of science. We must then ask the question: Has science developed so much over thirty years that the man-in-the-street believes it is just too difficult?

An interesting response to this question may be found in an International Science Council Occasional Paper from 2021[9]. It refers to a public information overload on matters such as artificial intelligence, automation, social media, biodiversity, vaccination, and genetic modification. Covid vaccine resistance highlighted a polarisation of opinions probably due to a growing scepticism about politics in science as well as increasing awareness of social justice and accountability issues. The pace of digitisation has fractured, polarised and overloaded the information sources while social media has blurred the line between producer and audience. It is no wonder that parents are confused about science.

The paper suggests that the onus is largely on the research community to change these perceptions and bring pure science back into the public domain. Scientific literacy is essential but social, political and economic variables have considerable effect. Conditions of scientific and

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technological development, religion, education, standard of living, and political orientation all have significant, but complex, impacts on public perceptions of science, including trust in science, and perceptions of controversies such as the COVID-19 pandemic and climate change. In this regard, perceptions of science can be understood as cultural constructs. Scientific institutions would benefit from continued reflection, debate, and research on the complexities of the many 'cultures of science' across the world[9].

In addition to the way institutional science presents itself, science education in schools could begin to offer perspectives on the cultural and social constructs of science. There would be a need for teacher education in that area.

A 2021 study of STEM students in the United States[10] showed that the classical scientists who developed unifying theories, as presented in the classroom, did not represent the diversity of student identities. In fact, the scientists were predominantly white European males. An intervention presenting a greater diversity of scientists noticeably changed the students' perceptions of who can be a scientist.

6. THE AUSTRALIAN SCENE

According to news reports scientific research in Australia is currently experiencing a crisis in terms of funding and recognition. We might ask 'has this turned potential scientists away?' The answer is probably 'no'. It has been reported that in Australia there are currently many more STEM students in universities than the number of potential jobs that will be on offer in the future[11]. This could indicate that the interest in a science career may still be strong, but these students may need to employ their skills in a different field in the workforce.

The Australian Academy of Science notes that "with just 0.3 per cent of the world's population, we have contributed to more than 4 per cent of the world's published research"[12]. Science is very important to this country. Educators and career counsellors must be cognisant of the current climate as well as the underlying factors which direct young people to follow a science path. Career knowledge and expos offer a great opportunity to present science opportunities to students but much more needs to be done to clarify and promote science in the public arena.

There is also a question of "do we need more scientists?" A 2021 article published by the Australian Academy of Science[12] highlights the problem that most research is carried out by post-graduate students rather than professional scientists. Most of the research is classified as 'applied' or 'experimental development' as this attacts more funding than 'fundamental' projects designed to acquire more knowledge.

7. CONCLUSIONS

This has been a brief look at some more recent key research that might inform changes in student science-track decisions. The main points uncovered were:

- Thirty years later, family members are still the major influencers in a student's career decisions.
- The original research pointed to early childhood science experiences being important factors in orienting students towards science. There has been a great deal of research and implementation in this area over the past thirty years.
- The extensive media coverage of major world events such as the pandemic and climate change as well as changing economic situations, information overload and fewer employment opportunities has negatively impacted the public perception of science.
- Social media does not appear to have had any significant effect on science career decisions.

8. RECOMMENDATIONS

Several changes in the way science is presented are suggested to rectify the somewhat tainted image it has developed.

- **Public Awareness:** Members of the public need to be better informed on what science is and what scientists do. It is the task of scientific organisations to take the initiative here in order to attract more suitable young people into science careers in the future.
- **Teacher Practice and Training:** Ongoing development of early childhood science experience is recommended. It is essential that teachers be made more familiar with 'doing science' and begin to use the language of doing rather than 'being a scientist'.

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- **Perceptions of Science and Scientists:** Students should be presented with a diverse range of scientists and more detail on their activities. It would be highly desirable to invite current scientists into the classroom to share their experiences with children. In this way a greater number of young people might identify with the image of a working scientist.
- **Scientific Organisations:** Australia's scientific community should be opening up more positions for the future. If there are well paid jobs available, the students will be more attracted to careers in those areas. There is also a need for more funding applied to fundamental research which is currently regarded as having a lower commercial potential. There is a need for a shift in the public perception of science as a source of new knowledge and this is an aspect that schools can potentially encourage.

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