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### **Prospective Science Teachers' Images of a Scientist: An Exploratory Study**

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#### **ABSTRACT**

Like all other professions, scientists too have a stereotypic image. This image is far from the reality and creates an idealistic and alien persona of science and scientists among students, making it something distant from their life. But according to the contemporary documents, science and scientists should be relatable to the lives of students. For this, along with textbooks we need teachers who are able to understand that science is a social enterprise and scientists are social beings, thus helping students understand the same. But before that we need to know whether our future teachers have a realistic understanding. So this study aims to find out the images that prospective science teachers have about scientists. Thirty-six prospective teachers were a part of this study. They were given an essay-type task where they were asked to create a written sketch of a scientists' age, place of birth, physical appearance, early years, interests and hobbies, and religious beliefs. It was found that the images that the prospective teachers have are consistent with the stereotypic images that are depicted in the prescribed textbooks, and other educational and entertainment resources. The results of the study imply that although on one hand there is a need to re-look at the textbooks, on the other hand there is also a need to put stress on the efforts that need to be made by the teacher education programmes to enhance the understanding of prospective science teachers about science and scientists.

**KEYWORDS:** Image of scientists, prospective teachers, prospective science teachers

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## **INTRODUCTION**

When we think of a profession, a certain image comes to our mind which may largely be based on the stereotypical descriptions surrounding that profession. Why does this happen? Linda Gottfredson<sup>4</sup> gave the theory of circumscription and compromise, which explained how individuals hold certain images of professions and of the people involved in those professions. Children while growing up develop images of people around them, the work they do, and the status they are given by others. Even before they start to speak they are able to observe and assimilate information present around them. And so they develop stereotypes about people and professions which have more to do with gender, status, life styles, and personality traits than with actually the functioning in the profession<sup>3</sup>.

The same kind of stereotyping is seen when individuals are asked about scientists. Many researches have tried to find out the images that students and teachers hold about scientists. And majority of them have shown that a scientist is considered to be a white male, works alone in the laboratory, wears a lab coat, is bespectacled, has a beard, is organised in his work, but shabby in appearance<sup>1,2,7,12</sup>. Schibeci and Sorenson<sup>10</sup> described that by the time children reach their teen years they have had enough exposure to the stereotypic imagery and this image becomes established in their minds. Rampal<sup>9</sup> reported that school teachers show a similar stereotypic image when asked to describe the appearance and work of scientists.

The next question that arises is where do children get such stereotypes from? These popular images have always been present in the media<sup>11</sup> in the form of cartoons, movies, and novels. Initially the depictions of scientists were much varied than they are now, and showed scientists both as ‘diabolical madmen’, ‘harmless eccentrics’, ‘learned buffoons’, ‘distinguished professors’, as well as ‘disputing among themselves or in conflict with religious authority’. But now these images have been polished and the controversies, disputes, arguments, and tussle for power, have all vanished from the images or descriptions that represent scientists and turned it into a more ‘standardised’ image making the scientist as an ‘ideal’ individual.<sup>2</sup>

Another important source for the generation and strengthening of these stereotypes is the curricular textbook and other educational sources. Kerkhoven et. al.<sup>6</sup> analysed the science education resources ranging from textbooks to teacher-developed tools and found that three in four scientists were depicted as men in primary school textbooks. Yacoubian et. al.<sup>13</sup> in their analysis of Lebanese textbooks found that Lebanese scientists are almost absent instead they are predominantly European males and working alone, an image consistent with the images held by students and teachers. In the Indian context, Kaur<sup>5</sup> analysed two textbooks for classes 9 and 10, prescribed by the NCERT, and reported that majority of the scientists in the textbooks were European, only one out of twenty-two

was Indian. All scientists depicted in the textbooks were males of different ages, mostly from the 16<sup>th</sup> to 20<sup>th</sup> century. All, except one, were depicted to be dressed formally. Out of the scientists depicted with surroundings, barring one, all were depicted in academic situations.

### ***Rationale for the study***

In conformance to the National Curriculum Framework (2005)<sup>8</sup>, the teaching of science should be realistic and relatable to the learner. The image of scientists is one of the aspects that make science either relatable or not. Scientists should not be viewed as an idealistic, out-of-the-world person. Instead the students should be able to comprehend that scientists are from amongst them and that with hard work and determination they too can grow up to be scientists. To develop such realistic images we need teachers who themselves hold a realistic image of science and scientists, so that they can interact with students and help them understand the same.

Also, numerous studies have been done with school students' images of scientists and a few have been done with teachers. But there is a dearth of such studies with prospective teachers and that too in the Indian context.

So, this study aims to find out the perceptions or views that prospective teachers have about scientists thus filling in the gap in research and also to make an effort towards the development of future teachers having realistic ideas about science and scientists.

### **METHODOLOGY**

The study was carried out with prospective teachers who had entered into the Bachelor of Education programme and had opted for chemistry, physics or biology as one of their pedagogy subjects. A total of thirty-six prospective teachers participated in the study. An essay type task was conducted with the prospective teachers where they had to write their impression of a scientist. They were given the freedom to choose between Hindi and English for their write-ups.

The task student-teachers were given was as follows:

Imagine a typical day in the life of a scientist, and make a written sketch of the scientist taking into consideration, the age and place of birth of the scientist, the early life and socio-economic status to which the scientist belongs, the physical appearance of the scientist including attire, the habits, interests and hobbies of the scientist, and the religious beliefs of the scientist.

The participants were coded as S1, S2, S3, ....S42, and as this is a qualitative study, the responses obtained were categorised into themes that were generated from the data itself and all the participants falling into respective categories were recorded. To make the data categorization reliable another coder was involved. The second coder independently did the same task as the researcher of categorization of responses into themes.

### **RESULTS**

The written description was analysed to understand how the prospective teachers view the scientists as a person on different aspects that they were asked to write about. This section gives a qualitative description of the findings for each aspect.

### **Age**

While some of the participants thought that there is no age limit to be a scientist (22%), some believed that scientists are youngsters (28%), but more than half of them (53%) believed that scientists are older people in the age group of 45 and above, and are always someone who has lived most of their life by the time they 'become scientists' as was evident from the response of S27 '*लम्बी अवस्था तक research करने में उनकी आधी आयु निकल जाती है*' (due to long years in research they have spent half of their lives), S32 '*...ज्यादातर scientist काफी ऐज पर बनते हैं*' (...most of (them) become scientists at older ages), and S33 '*the abilities of the scientists are realized by the society... by that time the scientist has already lived most of his life*'.

### **Place of Birth**

One-third of the respondents were of the view that a scientist can be born at any part of the world (eg: S1 wrote '*विशेष place of birth नहीं होता है...महलों में भी पैदा हो सकता है और झोपड़ियों में भी*' (no special place of birth... can be born in palaces or huts)) and a small number (5%) thought that scientists were born outside India. It was interesting to see that a substantive number of the prospective teachers (61%) were of the view that people who become scientists belong to small places or villages where people are not very educated as can be seen from the responses of S3 ('...mostly they are from poor families and small places that are unknown') and S27 ('*उनके जन्मस्थान ग्रामीण क्षेत्रों में ही होते हैं, क्योंकि अधिकतर वैज्ञानिक के माता पिता अनपढ़ होते हैं, जिसकी वजह से उनका निवास स्थान गावों में ही होता है*' (the birthplace is in villages, since the parents of most of the scientists are illiterate, so their place of residence is in villages)).

There were two prospective teachers whose responses need to be taken into notice. They believed that scientists are not always from small places and that the place of birth can affect the work of the scientists as the selection of problems that they research can be dependent on their own life experiences.

### **Early Life**

More than half of the participants (58%) had the view that the scientists see difficult circumstances in their early life and one fourth opined that despite difficult circumstances the

scientists are people who are determined and hardworking such that they are able to make themselves and their work notable (S3 wrote, '*in early years, money would have been scarce. There was a small house and low wage jobs. He (scientist) attended college with difficulty...intelligence and hardwork make him famous.*')

Almost half of the participants (47%) believed that people who become scientists were creative and good at academics since childhood (S17 wrote, '*he is a person who may or may not be a perfect student in school, but he topped his class in higher education*').

### **Socio-economic Status**

Three of the thirty six prospective teachers were of the view that scientists can come from any socio-economic strata of the society, and eight of them were of the view that the expense of academic and professional resources that the scientists need to be successful can only be fulfilled by someone with a good financial background. It was interesting that a substantive portion of the participants (69%) believed that those who become successful come from families that are financially weak and since they are hard-working, the monetary difficulties do not act as barriers for the scientists in achieving their goal (S29 wrote, '*अपने घर की उन हालातों से जूझ कर और कुछ पाने की चाह में ही वहां तक पहुँचते हैं*' ('*fighting the circumstances of their home and the hunger to find success they are able to reach the status*')) The same belief was articulated in the earlier aspects of '*place of birth*' and '*early life*'.

There were five prospective teachers who opined that it doesn't matter whether the scientists have money or not, because eventually they spend all their money on their studies and work.

### **Physical Appearance**

More than half of the participants (58%) viewed scientists having a simple dressing style, half of the prospective teachers (50%) believed that they wore formal clothing, and 14% said scientists did not dress in costly and fancy clothes. Some of the participants (11%) said that scientists did not have the time to dress immaculately, as they were more concerned about their work than their looks (S5 wrote, '*अपनी ड्रेसिंग पर ज्यादा ध्यान नहीं देते हैं क्योंकि जो उन्हें इन्वेंट करना होता है उस पर ज्यादा ध्यान देते हैं*' ('*they do not give much attention to their dressing as they are always giving attention to the things they are inventing*')). There were three student teachers who opined that there is not set style of dressing for scientists. Some of the other views showcased that scientists were shabby in appearance i.e. they had '*wrinkled face*' (S10), '*long and white hair*' (S10, S21, S22, S28), '*wore spectacles*' (S10, S30) and '*gloves*' (S10).

### **Habits, Interests, and Hobbies**

Almost half of the future teachers (47%) viewed scientists as introverts who like to live alone, have few friends and are not vocal.

About half (44%) said that scientists are curious, try to find new things and gain knowledge, so they like to read a lot (30%). Some of respondents articulated that scientists are people who take deep interest in the nature/things around them (19%), perceive things differently (8%), and try to solve problems till they succeed (6%).

Quite a few prospective teachers (42%) were of the opinion that the scientists love their work and are almost always engrossed in their research, such that they often forget to sleep, eat, groom, and dress and thus often have a shabby appearance. 17 % of the participants believed that though they may be careless about themselves they are always punctual and organized when it came to their work. This was consistent with the views expressed in the aspect '*physical appearance*'.

There were few who opined that scientists '*write books*' (S4), they '*teach children free of cost*' (S4), '*respect people*' (S10), '*do not like subjects like history*' (S11), '*give importance to academic performance*' (S12), and are '*tech-geeks*' (S21).

### **Religious Beliefs**

Some of the prospective teachers (19%) were of the view that scientists believe in God, 8% said that some may and some may not believe in God, and 17% said that they believe in all religions. About half of the participants (47%) opined that scientists do not believe in God and are not involved in any religious practice (6%) except when '*they do it as a duty*' (S10). They articulated that scientists believe '*in man making his own destiny*' (S3) and that they '*keep only natural phenomenon in mind*' (S15).

It was interesting to find that irrespective of whether the prospective teachers viewed scientists as believers or non-believers of God, majority of them (76%) were of the view that scientists are people who believe in humanity, respect people of all religions and faith, and treat them equally.

## **DISCUSSION**

The analysis of the images held by prospective teachers about scientists showcases the largely stereotypic descriptions already prevalent in the textbooks and media.

Throughout the imagery of the prospective teachers it can be seen that scientists are viewed as people who are different from the 'normal' people and generally are introverts. They are viewed as persons who have deep interest in their work such that they are unaware of their surroundings and themselves and thus are portrayed as having very simple or sometimes unkempt appearance. This image is

consistent with the image of ‘harmless eccentrics’ and ‘learned buffoons’ as described by Chambers<sup>2</sup>. The student-teachers do not realise that scientists are not much different from the ‘normal’ people and the personality types and dressing styles of scientists are much varied than those represented in books and movies.

It is also interesting that the students in majority view scientists as those who have struggles a lot in their lives, fighting poverty and other hardships, to change their own life and bring fame to the obscure town or village they were born in. The students are unable to understand that scientists can come from all walks of life, from all kinds of financial backgrounds, not always from small unknown places, and not necessarily be the ‘superheroes’ that they are imagined to be.

There is also a view that scientists are people who have lived most of their life by the time they achieve the ‘status of a scientist’. They are unable to comprehend that a person as soon as he or she starts working on any form research in any field of study becomes a scientist, and that not all scientists get the fame and attention like the prominent ones mentioned in the textbooks.

Though there was no consensus on whether the scientists believe in God or not, there was one line of thought that was articulated by the majority, that scientists are humanitarians who uphold the values of equality and un-biasness. Student-teachers are unable to comprehend that just as science, being a social enterprise, is not always a platform of equality or unbiasedness, the scientists being humans and social animals are not the ‘idealistic’ people that they are thought to be.

One important aspect that was noticed during the analysis of the written sketches of the future-teachers was that while describing a scientist, the pronoun ‘he’ was used in all the write-ups. This was an unconscious elucidation showing that the scientist as a professional is thought of as a male, and the reason for this is due to the depiction of largely male scientists in textbooks and media, and also due to the glaring underrepresentation of women in science.

## **CONCLUSION**

The images of scientists held by prospective teachers are consistent with those that are depicted in the curriculum and also get reflected in the students’ images of science and scientists. Rectifying these images and bringing them closer to reality will need a change in the curriculum as was emphasised in the National Curriculum Framework (2005), ‘helps the learner to view science as a social enterprise and to understand how social factors influence the development of science’ (p3)<sup>8</sup>.

The focus of textbooks should change from mentioning personal traits of only the scientists who struggled to get through their financially weak backgrounds, not showing scientists as people of family, not showing scientists as people who can have interests other than science, to showing scientists in contexts that portray the reality such as with family, working in groups, settings other than labs, etc. These images will help students relate more to the scientists thus motivating them to

take interest in science and not view it as an intangible, alien body of knowledge developed by people who are different than ‘normal’ people.

It should also be taken into consideration that the image of scientists is also perceived to be that of males, and so the textbooks should include more women scientists and the curriculum should have space for discussion of the under-representation of women in the field of science. This has also been recommended by the National Curriculum Framework (2005), ‘The curriculum should strive to make the contribution of women in the field of science and technology visible’ (p30)<sup>8</sup>.

Some amount of effort is also needed on the part of the teacher education programmes. Since the prospective teachers entering the programmes come carrying the stereotypic images of science and scientists as depicted in the textbooks, and to develop teachers with a better understanding of the world of science and the development of science, the responsibility falls on the teacher education programmes.

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