

# Models of Science and Scientists in the Literature and among Contemporary Learners

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## Introduction

Models of science and scientists were investigated during the last 50 years among learners, pre-service teachers and acting teachers, most of them concerning the scientist's appearance and social abilities (Mead & Metraux, 1957; Beardslee & O'Dowd, 1961; Sagan 1995; Song & Kim, 1999 ;Rubin, Bar & Cohen, 2003). The scientist is depicted as a white male wearing a white laboratory robe, working alone in the laboratory, using conventional equipment dated from the end of the 19th to the early 20th century. He has a high cognitive abilities: intelligence and diligence: "working for long hours". Generally, he has no social abilities and is interested in "domains that no logical man is interested in". In this research we tried to validate these images using different tools.

Very few studies have examined student's perceptions of the role of scientific achievements in society, and what should be the connections between the scientific community and the government (e. g. Stoker & Thompson, 1969; Aikenhead, 1987). Fleming (1987) investigated this issue using general statements that had to be confirmed or rejected and then explained. Checking the relationship between science, society, and government and the threat or progress perceived in science and technology were carried out in-depth in this investigation. The uniqueness of this study is the investigation of emotional aspects adheres to science and scientist in our society during the history - some of them positive, others expressing suspicion and fear.

For that purpose investigation of the scientific images which appears in classical creations since the 18<sup>th</sup> century till the 20<sup>th</sup> century, was made. These images were compared to the scientific images of temporary participants. An in-depth study as done here has not yet been carried out either in Israel or abroad. Some of these images have developed into social myths and symbols, leaving their mark on our attitude to science (Haynes, 2001). For this reason this study is important.

## Method

The research was carried out in two stages.

1. A survey of creations since the 18th century, both books and films, which expresses emotional attitude toward science.
2. An empirical investigation of contemporary learners views about the science and scientists images.

## Population and samples

The sample consisted of 131 participants coming from six groups. Five groups of high school pupils (125 participants, 54 male and 71 female), 76 of them were of religious back-ground and 54 of secular back-ground. All the high school pupils are of high achieving back-ground. The study was completed with 6 teacher student, five females and one male.

## *Description of the study and its tools*

The study was a mixed qualitative quantitative study. It consisted of a questioner that contained both open and closed question. The questioner was aimed at finding the attitudes of the participants towards scientific research and technological tools, useful but also threatening, the relation between society-government and science supervision. The open questions contains episodes taken from the surveyed literature, or ideas that appeared in them, to check views towards moral issues which confront scientists.

The questionnaire was presented to the high school pupils as a written test, and in an oral mode to the teacher students. The other two tools were a group discussion on the moral image of the scientist influenced by a movie (Frankenstein), and an open essay

about the images of science and scientist. The problems that appeared in these tools were aimed to create conflict, and indeed resulted in contradictory answers as will be explained latter.

## Results

### ***Models of Science and Scientist(s) in Popular Science and Classic Literature***

Models described by classical writers reflect fear and resentment against scientific knowledge:

1. The scientist is disappointed with science; he feels that he had wasted his life in a pursuit after something that cannot be found in the formal knowledge. In his pursue after another kind of knowledge the scientist chooses to make an agreement with the devil and he is doomed. This model is suggested by Goethe in *Faust*. (Stern, 1818)

2. The scientist is irresponsible about the out comes of his research causes damage to the society and to the environment. . This was clearly evident in *Jurassic Park* (Spielberg, 1993).

3. Some research should not be carried out it is against religion, dangerous, offend the people or impractical (Brecht, 1955).

4. The scientist who is emotionally detached

The three scientists in the famous play *The Physicist* (Dürrenmatt, 1988), present an image of scientists alienated to human lives and feelings. Their abilities are strictly analytical.

5. Scientists misuse the products of their research: to do evil, use these products as weapons, use them for revenge or since they are avaricious. (i.e. *20,000 miles under the water*, Verne, 1869).

6. The mad and dangerous scientist

The image of the mad scientist emerges from the “Frankenstein experiment” (Shelly, 1818). Frankenstein is the scientist whose ambition cannot be controlled. He ignores the warnings of others, "behaving as god", and creates a living creature.

7. Science and scientists are impractical. This image portrayed by Swift (1726) who denied the usefulness of science in regulating our lives.

8. The scientist has no social abilities, science is detached and uninteresting. The scientists of *Laputa* (Swift, 1726) are having “supreme thoughts, till they aren’t able to talk and hear others”.

The authors mentioned above are reflecting these emotions of fear and resentment regarding the scientific ideas, scientific inventions of their time, and some of their uses: since Galileo dispute about the solar system cosmology that clashed with the accepted views of his time, and was considered against religious faith (Brecht, 1955). It continues with Merry Shelly who warned against some uses of electricity (Shelly, 1818). Misuses of chemistry and optics were found in Wells and Stevenson novels, and the fear caused by the manifestation of the nuclear power in the form of the nuclear bomb was described in the play *the Physicist* by Durrenmatt (1988). Today's authors such as Le Carre (1999) and Crichtone (1993) speak about the dangers and miss uses of Bio-technology and the corruption of the drug corporations.

The model of science in popular science books is different from the unfavorable descriptions sited above. The scientists are praised as working to fight disease and develop science (*Microbe Hunters*, Paul De Kruif, 1926). In books written by acting scientists the hard work of the scientists, the need to scale and rescale the instruments, the caution needed in order to conclude and generalize are described. But, on the other hand the beauty of science and its rewards are emphasized (Smoot, 1993). In one of these books a scientist who prefers a scientific theory different from his own was described. This scientist changed his views since he was convinced that the other theory describes the experimental observations better than the interpretation that he firstly suggested to them in his own theory (Shapley, 1967).

### **Contemporary learners views about science**

#### **The scientist image**

The students' perception of the scientist was mainly positive. As in previous research, they think that the scientist is intelligent, diligent and dedicated to his work and has the ability to resist social pressure. In the written essay a more complex image is found. The image of the scientist ranges from friendly and sociable to frightening and having a very strange personality: "his wisdom can lead him to undesirable results".

### **The progress and the threats of science**

The participants have mixed views about the progress and the threats of science. Almost all of them support the research on the prevention of diseases. The conception of utility was their most common rationale. Other reasons given for supporting some research disciplines are interest and enjoyment and the resultant knowledge from the field of research. Rejection of some scientific research (like astronomy and geology) was justified by the grounds that it is impractical. The participants are pro-technology as regards to transportation accessories and they oppose weapons and nuclear reactors which they regard as harmful

### **The relationship between science, society, and government**

Half of the participants believe that the scientist's report of his finding is influenced by economic, personal or a combination of factors. Others feel that every case stands on its own merits: as the accuracy of the report depends on the scientific field, and the social responsibility of the scientist who carries out the research. More than half of the students feel that a scientist should not be under pressure to advertise his discoveries. Scientists and government should work together to determine the field of research, always keeping in mind its benefit for the individual. The scientist's professional motives should be considered; with the advancement of research and the progress of humanity are very important targets of scientific undertaking, even if the individual can be harmed in the process. Some said that the agreement of the individual to submit to dangerous experiments can minimize the responsibility of the scientist. But others opposed sacrifice of life under any circumstances.

### **Identification of participants with some images mapped in the classical and popular book creation and their moral response**

A group of high school students from the main research population watched the movie *Frankenstein* and discussed his image. Most of them opposed this experiment (creating a living creature from pieces of dead bodies). They objected to the idea that a human being can create life, because it goes against God's laws and human reason. The participants felt that the researcher's (Frankenstein) behavior "borders on madness". Several of them emphasized his lack of responsibility toward the creature he created. Many opinions, regarding Frankenstein behavior, were ambivalent: "he has good intentions, but his performance was bad". But they thought that: "real scientists are reasonable"

### **Comparison between the images that were mapped in the creations and those given by the participations**

Comparisons between these two sources show that fears expressed in classic works since the 18<sup>th</sup> century, were expressed by students of the 21<sup>st</sup> century. Students are sensitive to the negative and ambivalent images of science revealed in the literature. This concern nuclear reactors, evolution, bio-technology and virus research in general. A big difference was noted between the practical attitude toward knowledge shown by students, and the image portrayed by Swift (1726) who denied the usefulness of science in regulating our lives. Swift's unsocial and unemotional scientists who: "have such high level of thoughts that they aren't able to talk or hear what the other is saying" appears in our participants views: "on one hand, his (the scientist) actions are designed to improve mankind's condition, and on the other hand you have to doubt his functioning as a human being".

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### **Conclusion and implications**

This study is about the perception of students towards the morality of science and scientists. It is a pioneer study. Its main recommendation is to strengthen the validity of the results through additional studies and extending the questionnaire. It is recommended to perform an additional study, among other population groups.

It is important to offer the option of regarding science as interesting beyond the efficiency of research as a source for developed technology, or as a means for curing disease. We suggest exposing students to science-related works, similar to those analyzed in the creations analysis. Popular science books, written by the researchers themselves, will introduce the students to real scientists and their work methods. The collective interview method was found to be particularly suited to the special population that took part in most of this research. This method should also be adopted for instructing a more extended population whose characteristics are similar to those of the main research, and used for discussing ethical and complicated issues.

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## Bibliography

- Aikenhead, G.S. (1987). High-School Graduates' Beliefs About Science-Technology-Societs. III. Characteristics and Limitations of Scientific Knowledge. *Science Education*, 71 (4), 459-487.
- Beardslee, D.C. & O'Dowd, D.D. (1961). The college student image of scientist. *Science*, 133, 997-1001.
- Brecht, B. [1955] (2006). *The life of Galileo*. Amazon com books
- Durrenmatt, F. (1988). *The physicists*. Continental book company.
- Chrichton, M. (1993). *Jurassic Park*. New York: Random House.
- Fleming, R.G. (1987), High-School Graduates' Belief about Science-Technology-Society. II. The interaction Among Science, Technology and Society. *Science Education*, 71 (2), 163-186.
- Haynes, R.S. (1994), *From Faust to Strangelove*. London: The Johns Hopkins Press.
- Le Carre, J. (1999). *The constant gardener*. Cornwell d.
- Mead, M. & Metraux, R. (1957). Image of the scientist among high-school students: pilot study. *Science*, 126, 384-390.
- Paul De Kruif , 1926. *Microbe Hunters*. New York: Harcourt Brace & Company.
- Rampal, A. (1992), Images of Science and Scientists: A study of school teachers views. I Characteristics of scientists. *Science Education*, 76 (4), 415-436.
- Rubbin, A. Bar, V., & Cohen, A. (2003). The Images of Scientists and Science among Hebrew- and Arabic- Speaking Pre-Service Teachers in Israel. *International Journal of Science Education*, 25 (7), 821-845.
- Sagan, C. (1995), *The Demon Haunted World: science as a candle in the dark*. New York: Random House.
- Smoot, G. (1993), *Wrikles in time*. New York: Random House.
- Shapley, H. (1967). *Galaxies*. New York: Harvard University.
- Shelley, M. [1818] (1992), *Frankenstein*. Edited by Johanna M. Smith. New York: St. Marin's Press, 1992.
- Song, J., Kim, K.S. (1999), How Korean students see scientists: the images of the scientist. *International Journal of Science Education*, 21 (9), 957-977.
- Stern, J.P. (1818) [1987]. *Faust*. U.S.A: Cambrige University press.
- Stoker, A., & Thompson, P. (1969). Science and Ethics: A radical approach to high school science. *Science and ethics*, 53(3), 203-222.
- Spielberg, S. (Director) (1993). *Jurassic Park* [videorecording]. United State.
- Swift, J. (1726)[1906] *Guliver travels*. London: Routledge.
- Verne, J. (1896). *20000 Leagues Under the Sea*. Paris: Herzel publication.
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