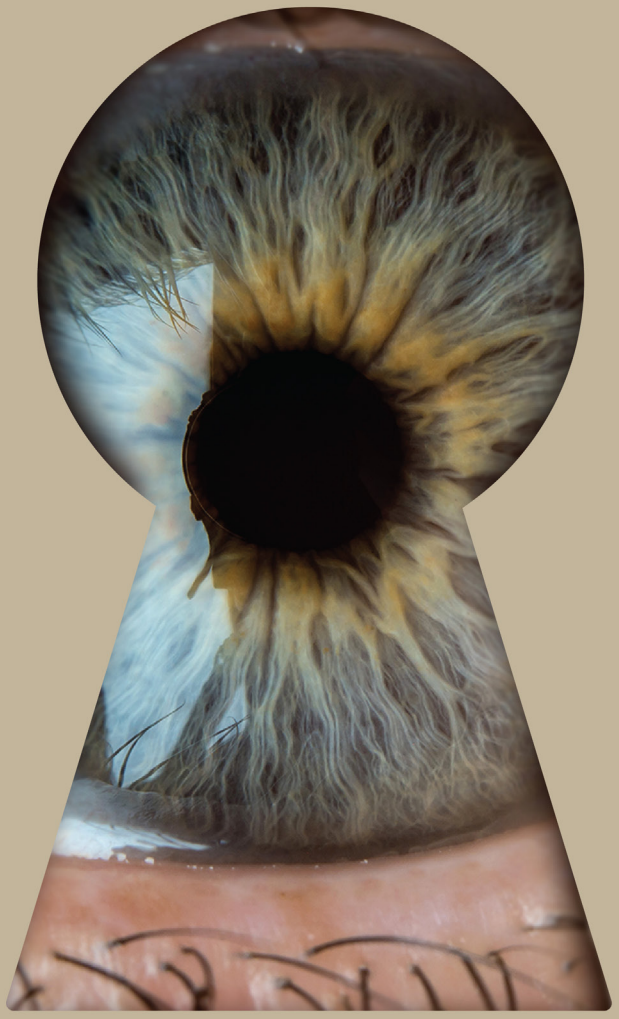
VOL V

Ciências Humanas:

Estudos Para Uma Visão Holística Da Sociedade



Silvia Inés Del Valle Navarro
Gustavo Adolfo Juarez
(Organizadores)

EDITORA ARTEMIS
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PRÓLOGO

"No nos interesa solamente cómo hacer que alguien aprenda.
Nos interesa también entender cómo tendría
que construirse el conocimiento si el fin es su aprendizaje."
Ricardo Arnoldo Cantoral Uriza

Fundó un campo de investigación sobre los procesos de construcción social del conocimiento matemático avanzado, acuñado como Teoría Socioepistemológica de la Matemática Educativa
Distrito Federal, México, 25 de agosto de 1958 - Distrito Federal, México, 30 de diciembre de 2021.

Una vez más tenemos la oportunidad de acompañar a los autores, participantes de esta publicación del Editorial Artemis. Esta vez, en su quinto volumen de la obra titulada **Ciências Humanas: Estudos para uma Visão Holística da Sociedade.**

En ella se muestra la gran preocupación por la búsqueda de nuevas formas de alcanzar el conocimiento de diversas ciencias y áreas disciplinares, mediante la democratización de saberes, que se pueden obtener en diversos escenarios, respetando aspectos sociales, culturales e históricos. Estos se implementan ante problemáticas de género, ambiente, religión e histórico, proponiendo entre los recursos, la organización de exposiciones en el aula, desde lo tradicional a las de tipo colaborativa, re-pensando la educación infantil a través de prácticas, que desarrollen la imaginación, creatividad, competencias, experiencias emocionales y alentadoras. Tanto los niveles, desde la educación infantil, hasta el ingreso universitario, son de interés en los re-planteos de la nueva educación, como así también, el rigor, tanto en ciencias duras como matemática, pasando a la ingeniería, y contaduría, como la participación de la mujer en diversos tipos de educación, y de la comunidad en general, apuntando a un conocimiento contra-hegemónico, poscolonial, indígena, arqueológico y antropológico social, que llevan a un todo, a lo que podemos llamar la ***sociedad del conocimiento***.

Es por ello, que debemos valorar las expectativas de los autores e investigadores que todavía sienten la necesidad y el deseo de entregar sus esfuerzos en la causa de la difusión de resultados de sus trabajos científicos.

Esperando que estos trabajos sean de gran aporte a los lectores, les deseamos una buena lectura.

SILVIA INÉS DEL VALLE NAVARRO
GUSTAVO ADOLFO JUAREZ

PRÓLOGO

"Não estamos interessados apenas em como fazer alguém aprender.
Também estamos interessados em entender como
para construir conhecimento se o fim é o seu aprendizado."
Ricardo Arnoldo Cantoral Uriza

Fundou um campo de pesquisa sobre os processos de construção social do conhecimento matemático avançado, cunhado como Teoria Socioepistemológica da Matemática Educacional.
Distrito Federal, México, 25 de agosto de 1958 - Distrito Federal, México, 30 de dezembro de 2021.

Mais uma vez temos a oportunidade de acompanhar os autores, participantes desta publicação da Editora Artemis. Desta vez, no quinto volume da obra intitulada **Ciências Humanas: Estudos para uma Visão Holística da Sociedade.**

Mostra a grande preocupação com a busca de novas formas de alcançar o conhecimento das diversas ciências e áreas disciplinares, por meio da democratização do conhecimento, que pode ser obtido em diversos cenários, respeitando aspectos sociais, culturais e históricos. Estes são implementados diante de problemas de gênero, meio ambiente, religião e história, propondo entre os recursos, a organização de exposições em sala de aula, do tipo tradicional ao colaborativo, repensando a educação infantil por meio de práticas que desenvolvem a imaginação, criatividade, competências, experiências emocionais e encorajadoras. Ambos os níveis, desde a educação infantil, até o ingresso na universidade, interessam no repensar da nova educação, assim como o rigor, tanto em ciências exatas e matemática, passando para engenharia, e contabilidade, quanto a participação de mulheres em vários tipos de educação, e da comunidade em geral, apontando para um conhecimento contra-hegemônico, pós-colonial, indígena, arqueológico e socioantropológico, que conduzem a um todo, ao que podemos chamar de sociedade do conhecimento.

Por isso, devemos valorizar as expectativas de autores e pesquisadores que ainda sentem a necessidade e o desejo de se empenhar na causa da divulgação dos resultados de seus trabalhos científicos.

Esperando que estas obras sejam de grande contribuição para os leitores, desejamos uma boa leitura.

SILVIA INÉS DEL VALLE NAVARRO
GUSTAVO ADOLFO JUAREZ

SUMÁRIO

CAPÍTULO 18

SCIENCE AND SCIENTISTS: MAIN SOURCES OF INFLUENCE IN THE CONSTRUCTION OF THESE CONCEPTS AMONG UNIVERSITY STUDENTS

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ABSTRACT: Science, scientific research, and the image of scientists, among other concepts, permeate different environments, which helps to consolidate social representations on these topics in the lives of many citizens. The school environment, where students spend much of their time, is of great influence. We depart from the theory of social representations, proposed by Serge Moscovici (1979) and some of his followers, such as Denise Jodelet and Banchs, who focus on the study of common sense as a system of values, ideas, and practices with a double function: to guide the social world and to aid communication between its members. The main assumption is that there are influences from all environmetns, but the academic ones predominate in the formation of social representations of science and of the scientist in students. Two hundred and ninety-seven (297) students from the University of Guadalajara, of different professional fields, participated. Through a questionnaire of open questions and an exercise of associative questions, analyzed through a mixed content analysis, we conclude that there are hegemonic social representations about the meanings of science, regardless of the career studied, as well as faintly accurate images about scientists, which invite academics to deconstruct them and foster a taste for science and research in the student body.
KEYWORDS: University students. Science/ scientist. Social representations. Formal media.

LA CIENCIA Y LOS CIENTÍFICOS: FUENTES DE MAYOR INFLUENCIA EN SU CONSTRUCCIÓN EN ESTUDIANTES UNIVERSITARIOS

RESUMEN: La ciencia, la investigación científica, la imagen de los científicos, entre otros, circulan en diferentes medios que ayudan en la consolidación de representaciones sociales sobre esos tópicos en la vida de muchos ciudadanos. El ambiente escolar, donde los estudiantes pasan gran parte de su tiempo, es de gran influencia.

Partimos de la teoría de las representaciones sociales propuesta por Serge Moscovici (1979) y de algunas seguidoras como Denise Jodelet y Banchs, que se enfocan en el estudio del sentido común como un sistema de valores, ideas y prácticas con una función doble: orientación en el mundo social y comunicación entre los miembros. La conjetura principal parte de que existen influencias de todos los medios, pero predominan las académicas en la formación de representaciones sociales de la ciencia y del científico en los estudiantes. Participaron 297 estudiantes de diferentes carreras profesionales de la Universidad de Guadalajara. Por medio de un cuestionario de preguntas abiertas y un ejercicio de preguntas asociativas, analizados a través de un análisis de contenido mixto, nos percatamos que existen representaciones sociales hegemónicas acerca de los significados de la ciencia, independientemente de la carrera estudiada, así como imágenes poco certeras del científico, que invitan a los académicos a descontruirlas y fomentar el gusto por la ciencia y la investigación en el estudiantado.
PALABRAS CLAVE: Estudiantes universitarios. Ciencia/científico. Representaciones sociales. Medios formales.

1 INTRODUCTION

The will, curiosity, and disposition that young people have to find solutions to the problems they experience day-by-day are often brought down by mistaken beliefs towards research, towards scientists, and towards science itself. If we want there to be development of scientific activities in our country, which are important factors for a better economic, cultural, and historical development, we must evaluate the possibilities that our young people can think of such activities as something real, desirable, and feasible.

The main objective of this study was to identify the social representations that students from the University of Guadalajara have built about science and scientists, representations that have been forged throughout their lives through exposure to different sources or environments. How do they conceive science and scientists? Do they imagine being a scientist enough to dedicate themselves to this profession? To what sources do they turn to for information on scientific issues? We depart from the belief that there are similar social representations of science in students, regardless of their field of studies, as well as not very accurate ideas about scientists; assumptions that partly prevent students from imagining themselves carrying out research tasks, being their main sources of influence the Information and Communication Technologies (ICTs) and formal education.

2 METHODS

2.1 THEORETICAL APPROACH

When Moscovici and Hewstone (1986) talked about the game of science and the game of common sense, they wondered about how people understand their world, or how they use the information transmitted either by science or by common experience. An essential assumption is, they said, that it all contributes to making science an integral part of our view of everyday life. For example, science is inseparable from intellectual life and social relations, and ideologies (on a large scale) and the so-called common sense (on a smaller scale) abound with images, words, and reasoning drawn from physics, from medicine, sociology, psychology, etc.

These authors explained that a close observation of the mental processes used by most people to apply the words, images or ideas of scientific origin reveal that they behave as if they were scientists without specialization (and even clumsy). That is, people retain the content, but modify its form and its rules; they transform it into common sense with all that this presupposes of their own thought and language.

The above leads to the initial conjuncture: why do people think like this in their daily lives? Moscovici and Hewstone strive to explain the difference between the ideal of thought in accordance with science and reason (scientific epistemology), and the reality of thought in the social world (popular or common-sense epistemology). This explanation goes through the theory of social representations, specifically for the epistemology of common sense.

The concept of social representation expresses a specific form of social thought: common sense, which has its origin in everyday life, and, at the same, time gives social thought an important role in structuring social reality. In this way, science, scientists, and what scientists do, for example, become relevant in the extent that they mean different things to students, because they have different images depending on how close or distant, they are to said concepts.

2.2 PARTICIPANTS

The study used a non-probabilistic sample by quotas, which initially considered 50 students per university center, an aspect that was difficult to achieve due to the formation of already established classes. The collection of data took place in the summer of 2015, a time when courses are offered to students of different courses and semesters, which facilitated the work since in this way it was possible to have a greater range of university courses studied and students of several semesters.

Table 1. Participating students from the thematic university centers of the University of Guadalajara.

	CUAAD	CUCBA	CUCEA	CUCEI	CUCS	CUCSH	Total
Women	26	19	39	16	27	25	**152**
Men	24	30	22	32	19	17	**144**
Did not answer	0	0	0	0	0	1	**1**
Total	50	49	61	48	46	43	**297**

CUAAD is the University Center for Arts, Architecture and Design; CUCBA: University Center for Biological and Agricultural Sciences; CUCEA: University Center of Economic and Administrative Sciences; CUCEI: University Center for Exact Sciences and Engineering; CUCS: University Center for Health Sciences, and CUCSH: University Center for Social Sciences and Humanities.

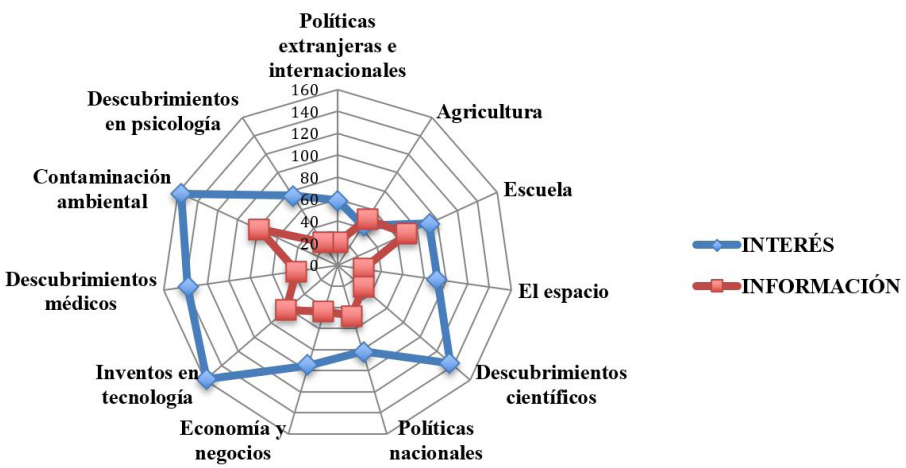
2.3 INSTRUMENTS

A questionnaire of multiple choice and open questions was used, as well as an exercise of associative questions. Both were validated through previous research, with the pre-test, post-test technique and pilot study. The analysis for the open answers was carried out through a mixed thematic content analysis (Piñuel Raigada, 2002; Shoemaker and Reese, 1994).

3 RESULTS

It was necessary to find out how much the students already knew about scientific topics to reach a general context. The students reported being more interested than informed in various topics related to science.

GRAPH 1. A lot of interest, little information.

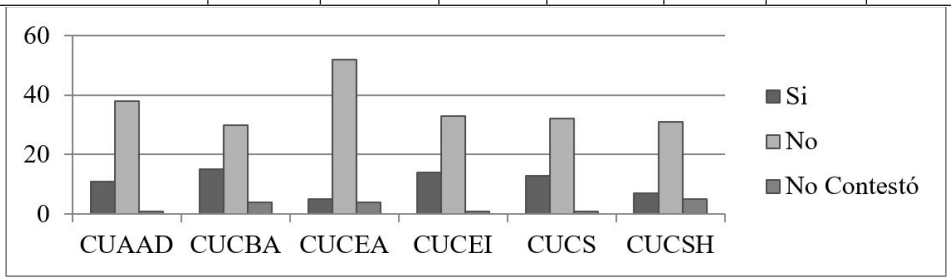


As Graph 1 shows, interest is greater than the information students have on the topics mentioned, except for the topic of Agriculture (CUCBA and CUCEI students excel in this topic, essential for their disciplines). SR theory explains that among the factors that affect the intellectual organization of a representation is the "degree of focus" which refers to the degree of involvement or interest that an object has within each social group; the more relevant an object is for a group, the greater the pressure to infer, that is, if there is a lot of interest in certain aspects or topics, this is manifested, even when it is known that there is little information on most of the objects, issues or aspects discussed.

Something similar happened to students' knowledge about the places where research is conducted in their respective university centers:

Table 2 and Graph 2. Do you know any institution, center, laboratory or other place where research is carried out at your university center?

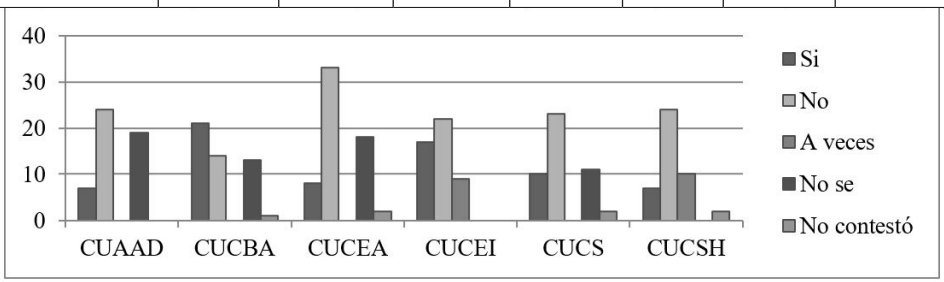
	CUUAD	**CUCBA**	**CUCEA**	**CUCEI**	**CUCS**	**CUCSH**	Totals
Yes	11	15	5	14	13	7	**65**
Nope	38	30	52	33	32	31	**216**
Did not answer	1	4	4	1	1	5	**16**
Totals	**50**	**49**	**61**	**48**	**46**	**43**	**297**



As Table 2 and Graph 2 show, 72.72% of students do not know any research places in their university centers, althoug there are several institutes, departments, research centers, etc., as the University of Guadalajara ranks first in Mexico´s western area for its research centers and for professors belonging to the National System of Researchers. Only 21.88% of the students have that knowledge, the vast majority being unaware of it. Although students show interest in science related issues, they hold little general or more specific information. This gives an indication that what involves science is not very significant for students, a finding that is related to the next answers:

Table 3 and Graph 3. Have you considered working as a scientist?.

	CUUAD	**CUCBA**	**CUCEA**	**CUCEI**	**CUCS**	**CUCSH**	Totals
Yes	7	**21**	8	17	10	7	**70**
No	**24**	14	**33**	**22**	**23**	**24**	**140**
Sometimes	0	0	0	9	0	10	**19**
I don't know	19	13	18	0	11	0	**61**
Did not answer	**0**	1	**2**	**0**	2	2	**7**
Totals	**50**	**49**	**61**	**48**	**46**	**43**	**297**



A large part of the informants (47.13%) would not consider working as scientists (except for those from CUCBA), some have sometimes thought about the possibility (6.39%), and almost a quarter (20.53%) did not think about the idea of working as a scientis. What are the reasons? In short, those who answered NO said: "I don't like it", "I'm not very good", "I'm not good at it", "it's tedious", "it takes a lot of dedication", "there are other priorities". Those who have SOMETIMES thought about it mentioned that: "sometimes it is interesting", "because I would like to do it", "it catches my attention, but not all the time". Those who answered YES mentioned: "I like research", "it is interesting", "to learn new things", "to help society".

Despite the previous answers, 58.80% did imagine themselves being a scientist, which would seem paradoxical (they do imagine themselves as scientists, particularly those from CUCBA, but they have not considered working as scientists). According to Moscovici (1979), there is cognitive polyphasia, that is, forms of thought that seem contradictory, but that exist in people's daily lives; we do not have a single way of seeing things, events or facts, although one vision predominates. The above is an illustrative case.

In terms of gender, the women are those who least imagine being scientists:

Table 4 and graph 4. Do you imagine yourself as a scientist?.

	YES	**NO**	**I DON'T KNOW**	Totals
CUAAD	10	**15**	1	26
CUCBA	8	**9**	2	19
CUCEA	16	**23**	0	39
CUCEI	**10**	6	0	16
CUCS	**13**	12	2	27
CUCSH	9	**16**	0	25
Totals	66	**81**	5	152

What are the reasons given by the students as to why they cannot imagine being scientists? Some of their answers are very clear and direct, such as "I don't like it" or "it's boring", but there are other reasons too.

> CUAAD: "Because I don't think *I would have enough aptitudes for what it is*", "How boring, right?", "No, because I don't see myself or imagine myself in a laboratory".
>
> CUCBA: "It is a lot of study about things that you do not know, long research processes (boring)", "It is not my area of greatest interest", "*I do not have the skills*", "If by scientist it means applying knowledge about science in the working life, then no because it is not what I would like", "It is not to my liking".
>
> CUCEA: "Because I don't like research related to science", "No, because I'm not attracted to this area of work, I don't like health research science", "Because *I'm not dedicated enough* to spend my time dedicating to just one thing", "Because *it requires being patient and analytical and I am not".*
>
> CUCEI: "I am more practical, research is not my thing because I would doubt my answers if I were a scientist", "Because *I consider myself a person with little patience* and I think patience is very important", "Because I am not interested", "Because I think that is not a field in which I would like to work".
>
> CUCS: "No, because I don't like it", "Because it would not be something that I could fully perform", "Because I feel that this would not be for me since *scientists are extremely dedicated and honestly I am not*", "It is *a lot of dedication coupled with many studies and people with a high level of knowledge and dedicated*, and besides I don't like it".

CUCSH: “No, because I think that *I would lack certain skills that great scientists have,* and thist is not an area in which I am interested in focusing”, “My passion is not in research, but in helping”, “Because it is boring, it is not interesting”, “Because I don’t think my career is scientific”.

The reasons why the students of the different university centers do not imagine themselves as scientists are varied; coincidences (highlighted in italics) are: not feeling capable, lacking skills, having insufficient intelligence, requiring extensive dedication to carry out said profession, and therefore, science is rather for men (*they are extremely dedicated*).

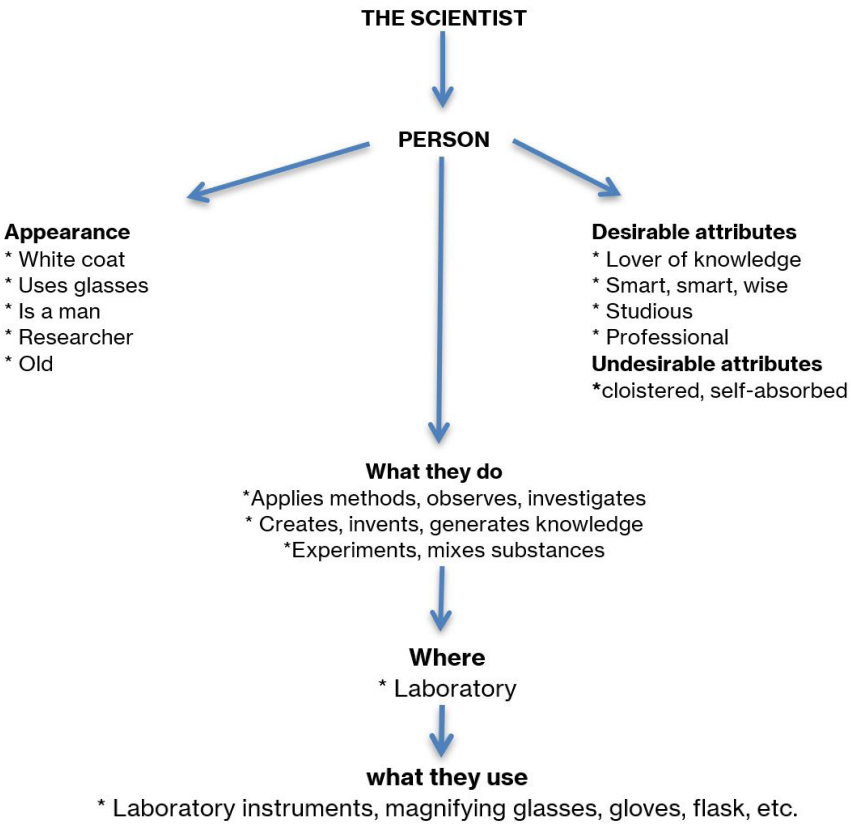
Bian, Leslie, and Cimpian (2017) conclude, after rigorous empirical study, that stereotypes about high-level intellectual ability (such as high intelligence) are associated more with men than with women. These stereotypes, the authors point out, discourage the pursuit of many prestigious careers by women; that is, women are underrepresented in fields whose members value intelligence (such as physics, mathematics, or even philosophy). These stereotypes are supported and influence the interests of 6-year-old girls since they are less likely than boys to believe that members of their gender are “really very smart”, and it is then that girls begin to avoid activities that are said to be for children who are “really very smart” These findings suggest that notions of gender intelligence are acquired early and have an immediate effect on children’s interests.

Now, what does science mean for students? In general, without making distinctions regarding affiliation to distinct university centers, since the answers were very similar, the students highlighted, in first place, the abstract processes that science contains, and in second place, the concrete processes (in third place we have the purpose of science, and in fourth place the procedures for the realization of science). The students, considering these responses, are more immersed in what science implies, rather than the end of it and its procedures.

We infer, therefore, that the social representations of “what science is” is oriented more to what is lived in the university. That is, what the students experience and live in different research methodology courses, protocol designs, research reports, thesis seminars, etc., they are more oriented to study something, a particular topic, with theoretical foundations, and perhaps for this very reason their ideas are reflected under those terms. They are hegemonic visions that have been built throughout their lives, in which there have been various kinds of influences, such as what was read and learned at school and in the university, what is seen and heard in the media, what is talked about

with family, friends, partner, etc. This is how the lateral and central determinants that Moscovici (1979) alludes to are those that influence, in a mediated way, the different social representations that people have of something or someone, in this case of science and scientists. In a very peculiar way, they conceive the scientist:

Scheme 1. Students view of Scientists.



As it is shown in Scheme 1, the stereotypes with which scientists have been classically associated stand out: the use of a white coat, related to an old man, very intelligent and self-absorbed, who works in a laboratory doing experiments. That is the typical image of the scientist. Despite the predominance of these images (which are not necessarily wrong but are oriented towards scientists who are dedicated to doing one type of science, and the problem is that it is generalized to all scientists), we find an issue that calls for attention.

About 42% of the students associated the scientific term with a “person”, rather than with a man or a woman; however, in previous studies (Domínguez, 201two; 2009), the

concept of the scientist embodied in men still prevailed, in contrast to the present, in which only 12.79% of the students referred to the scientist in masculine terms. Nevertheless, only 1.01% associate the term with a female scientist, and, let´s not forget, 53.28% of the female students said that they did not imagine being a scientist.

With respect to the sources and means of communication in obtaining scientific information, Banchs (2007:222) said that "the mass media are makers of representations to the extent that they select and disseminate information and highlight issues of interest". The influence and impact exerted by the media in the formation of images, tastes and opinions about various situations with which we are confronted on a daily basis, do not go unnoticed. The media, particularly television (in whatever format it is viewed, and the different programming it offers, including *streaming*), contribute to the formation of social representations of different aspects, and regarding science there is vast evidence in this medium (Domínguez, 2014). However, not everything can be attibuted to televisión, whose influence lasted a long time. When it comes to obtaining information on a specific subject related to science, another faster and more accessible medium is sought: the Internet. The following data confirm it.

Table 5. Main sources of scientific information for students.

MEDIA	CUAAD	CUCBA	CUCEA	CUCEI	CUCS	CUCSH	Totals
Internet	**37**	**36**	**42**	2	1	1	**119**
Friends or colleagues	2	1	3	**39**	**30**	**3. 4**	**109**
Radio	0	1	2	**13**	**16**	**12**	44
Professors	**8**	**12**	6	2	**6**	**9**	43
Books and/or written materials	**12**	**11**	**10**	1	1	4	39
TV	5	5	**8**	**4**	5	5	32
Magazines	5	7	3	2	1	3	21
Family	3	2	3	3	3	3	17
Periodicals	0	2	1	1	3	3	10
Other sources	1	0	0	1	1	0	3
Total	**73**	**77**	**78**	**68**	**67**	**74**	**437**

The Internet is the most used source for scientific information among students; and in particular for the students of the first three university centers (Table 5). For the students from the last three university centers the main source of information were "Friends or colleagues" (non-formal sources) to whom they go to obtain data or scientific information. However, it is necessary to read what is presented by university center, since

that is where the similarities or differences reside, and not the totals in the final right column, which in certain cases is essential.

For example, if we divide the means of information by formal sources (teachers, books or written materials; that is, the means through which an accredited education is received and recognition is given for it - a degree or a certificate, for example-), students from all centers access theses sources, but on a smaller scale. In this regard, the professors are in the third position for almost all of them, except for those in the schools of Economics and Administration and in the Exact Sciences and Engineering (in which teachers was not even their third alternative). It could be inferred that the teachers or professors are probably losing the recognition in erudition that they previously possessed, an aspect that should concern all those involved in teaching and research, but mainly university managers, who ultimately dictate what is done.

However, when the intention of the question changes, the answer is different, at least among the students. One thing is the most used source that students reach to obtain scientific information (Internet and friends, and we do not doubt that it is because they are more at hand and are the fastest and easiest way to obtain such information), and another thing is what sources they trust. The following table shows who students trust most to receive information on topics related to their career, where various aspects of science are included.

Table 6. Who do you trust most to receive information about topics related to your career?

TRUST IN PERSON/ SOURCE	CUAAD	CUCBA	CUCEA	CUCEI	CUCS	CUCSH	Totals
University scientist	23	24	35	25	21	22	**150**
Professor	20	24	27	12	15	15	**113**
Internet	6	5	4	5	12	6	**38**
Parents	5	1	6	6	2	8	**28**
Non-governmental organizations	0	5	7	5	3	4	24
Nobody	3	3	2	3	1	2	14
Journalist	3	1	4	1	1	1	11
Books	0	1	1	4	1	2	9
Colleagues	2	2	1	0	0	4	9
Others	2	4	2	6	3	4	21
Total	64	70	89	67	58	66	417

The first four sources are divided in three categories: formal sources, in which university scientists and professors are included and represent the largest group; informal

sources, as the Internet, and non-formal sources, in which parents are represented. There is no doubt that the sources most trusted by undergraduate students are university scientists and professors, in that order.

Then, it is necessary to distinguish the logic of the questions and the answers to understand the meaning given by the students. They may not have their professors as the first source of scientific information, but their level of confidence in the information received by their teachers is much higher. That is, formal sources of scientific information are of crucial importance in the formation of social representations, in this case of science and related aspects. This deserves to be considered by university policies, which orient guidelines that must be followed in the school curriculum, in order to promote a taste for science and therefore research.

4 CONCLUSION

Students are surrounded by various sources that influence them to feel, live, like, think, have information, knowledge, images, stereotypes, as well as certain attitudes towards science, and what it constitutes. It was observed that formal or academic sources, such as teachers, are essential because they contribute to the interest, or not, in scientific work among university students, who can be future researchers. ICTs were also a source, the Internet for example, which, due to the vast amount of information available, also causes misinformation.

The participating young students from the different centers of the University of Guadalajara have homogeneous social representations of science, as well as somewhat distorted images of scientists. Representations that, in the long run, can prevent them from approaching science and dedicating themselves to it as a profession. The challenges are great, but the most important, crucial thing, is that there is already an overview of what are the social representations of the students about scientists and science, which will allow working with these perspectives, with the goal of contributing to the establishment of university policies more aligned with this diversity of thoughts, knowledge, and feelings towards science, in order to build university policies that foster a taste for research.

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