

Study of the impact of the coronavirus on the conceptions of the Tunisian pupils concerning the microbes: Case of the first secondary year

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Abstract ;

In the total vagueness that accompanied it, the Covid-19 pandemic opened the doors to questioning science and its limits [1]. Faced with this, the school is supposed to contribute to health promotion, and the knowledge acquired within this framework should normally be mobilized in a context such as that of the Covid-19 pandemic. Our research is in line with this perspective and aims to understand whether students were able to mobilize school-based learning and use it to their advantage in dealing with the spread of the pandemic. To do so, we explored the conceptions of 607 first-year high school students about Covid-19, its origin, its modes of spread, and the precautions to take to protect themselves and others. Our results show that although the majority of these students are well aware of the health measures to be followed, they have difficulties in differentiating viruses from microbes and have misconceptions about the origin of the pandemic, mainly due to pseudo-scientific rumors conveyed by different media.

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- ✓ Student conception

1. Introduction

Pandemics have always had an impact on human life and have always left important traces in the memory of societies because of their consequences on many aspects of life, particularly health, psychological and even economic.

The Covid-19 epidemic, which started in China, spread far from its original home to the whole world in the first months of 2020. It has had a significant impact on the daily lives of humans and on society.

The pandemic of the coronavirus has generated metamorphoses at all scales and in all domains, notably the school domain. Indeed, there had been confinements and disruptions of schooling that have disrupted and delayed the teaching in all countries of the world.

This climate of fear and concern was fueled by the appearance of false information about health measures and certain therapies, the spread of which was facilitated by the use of the Internet. Learners have been exposed to inaccurate or misleading information and consequently misconceptions about the pandemic.

This didactic work is part of the general framework of research on this pandemic in relation to the educational environment and the teaching and learning of science. We propose to explore students' conceptions of certain notions related to this controversial subject: uncertainties about the use of certain antibiotics for this virus, uncertainties about its modes of transmission and even about certain preventive measures, such as wearing a mask.

2. Problem and research questions

Our research work is part of this perspective and our problem consists in identifying the conceptions of the students of the 1st year of secondary school in relation to what they learned at school, and to know if they benefited from it to face the propagation of the pandemic of Covid 19, in particular with regard to the teaching of the topic "microbe and health", in Life and Earth Sciences (SVT).

The present work is in the field of didactics and aims at analyzing the students' conceptions after teaching the topic "microbes and health" and see the impact of formal and even informal teaching on what is not teachable.

To answer our problem, we will try to bring elements of answers to the following questions:

- What are the students' conceptions about the origin of the Coronavirus and its modes of contagion?
- To what extent has the teaching of the chapter "microbes and health" been able to help 1st year secondary school students to engage in health promotion in the context of Covid-19 ?

3. Theoretical framework

3.1 The notion of an epidemic:

Since our study is directly related to Covid-19 let us begin by defining what an epidemic is. It is a disease that affects a large number of people in a community, population or region. History records many epidemics that mankind has experienced such as the plague, cholera, smallpox and many others.

12000 years ago, the Neolithic revolution and the appearance of agriculture and

animal husbandry favored the displacement of primitive human populations and the coming into contact of different human groups. This allowed the transmission of contagious diseases. The contact with farm animals has made possible the transmission of mutant viruses responsible for new diseases [2]. We are increasingly witnessing the appearance of new zoonoses. The Covid-19 virus could be an example. Since bats have been identified as the reservoirs of the current coronavirus.

It is common to use the term "pandemic" to refer to epidemics that spread over large geographical areas. In the 17th and 18th centuries, the terms epidemic and pandemic were used loosely and often interchangeably in various social and medical contexts. The first known use of the word pandemic, in 1666, referred to a disease that appeared in a country. Two centuries later, in 1828, the first edition of Webster's Dictionary by American epidemiologist Noah Webster listed epidemic and pandemic as synonymous terms.

Webster, who had survived the influenza pandemic of 1789-1790, refers in his dictionary to epidemic influenza, not pandemic influenza. Thus, by the early nineteenth century, the term epidemic, when used as a noun, had become the accepted term for what we would now call both an epidemic and a pandemic, with the term pandemic becoming less and less used [3].

Fortunately, the development of medicine has limited the damage and health consequences of these epidemics. However, the appearance of a new epidemic is always accompanied by new scientific and sanitary challenges and debates in the scientific and social spheres, as in the case of the Covid-19 epidemic [2].

3.2 The Covid-19 Epidemic

The recently emerged Covid-19 is a highly transmissible viral infection caused by

another new zoonotic coronavirus called severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). Like the other two coronaviruses, such as SARS-CoV-1 and MERS-CoV, SARS-CoV-2 is also likely to originate in bats, which served as the basis for the avian influenza epidemic and as established reservoirs for various pathogenic coronaviruses [4].

The first cases of Covid-19 were identified in late December 2019 in Wuhan, China. The disease turned into a pandemic within weeks. As of September 30, 2020, more than 33 million cases have been reported worldwide, with more than 1 million deaths [5]. The pandemic has reached 215 countries, and the infection is still spreading around the world.

The Covid-19 epidemic has created a sense of "déjà vu" with the severe acute respiratory syndrome (SARS) epidemic in 2003. Citing early estimates of disease infectivity based on an analysis of the first 425 confirmed cases in Wuhan, comparisons were made with the 1918-1919 influenza pandemic [6].

The virus was present in China long before the Wuhan outbreak. For many months prior to Wuhan, the new virus, known as SARS-CoV-2, had lain dormant because it had not encountered conditions that would have led to its epidemic awakening.

However, during the last decades of the last century, conditions have allowed SARS-CoV-2 to become dangerous and even deadly for animals and humans. These conditions are mainly related to the loss of biodiversity of ecosystems caused by the conversion of natural habitats into agricultural and/or urban ecosystems, which have increased the contact between humans and wildlife, and among them, reservoirs of potential zoonoses [7].

Bats have been identified as the reservoirs of the current coronavirus, and the spread of

the virus to humans is thought to have been caused by consumption of these chiropterans. Initial findings suggest that the cause of the emergence of the current epidemic is the consumption of bats. The practice of bat hunting is widespread in southern China, Southeast Asia, Africa, and some Pacific islands, and targets at least 167 bat species.

The virus was first called "Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2)" because of its genetic similarity to SARS (whose outbreak dates back to 2003). On February 11, 2020, the World Health Organization (WHO) named it "Covid-19". In the first two months of 2020, the virus spread from China to more than 143 countries, since when its spread has been exponential. WHO was initially reluctant to declare an international health emergency, then on January 30, 2020, Covid-19 was declared a global health emergency. On March 11, 2020, was declared the global pandemic of Covid-19 [8].

We cannot approach the subject of pandemics without exploring the notions of microbes, virus and bacteria. Part of our study is directly concerned with these notions, since it is important to master them in order to understand the way in which the disease spreads and the means to be put in place to avoid contagion.

3.3 Microbes

Microbial world is diversified. It can only be observed under the microscope. The microbe is a dynamic microorganism that belongs to our ecological environment different by their sizes, shapes and modes of action on the organism. There are 4 groups of microbes: protozoa, bacteria, microscopic fungi and viruses [9].

According to Guibert [10], our body is home to many microorganisms that are present on our skin, in the digestive, genital,

respiratory and other tracts. All these microorganisms are called the microbiota. The composition of the microbiota depends on age, state of health, environment and diet. The microbiota consists mainly of bacteria and microscopic fungi. Microorganisms are transmitted directly from one individual to another (by sex, blood, coughing, touching...) or indirectly by contaminated objects (water, food, contaminated objects). They then cross the natural barriers (skin and mucous membrane) and cause contamination. When pathogenic microorganisms multiply in our body, we say that there is an infection.

Microbes were already present billions of years before humans, and humans could not survive without them. They are the recyclers of the planet and ensure the continuity of life on Earth [11].

Today, microbes, or microscopic organisms, are widely used in large-scale industrial processes. They are crucial for the production of various metabolites, such as ethanol, butanol, lactic acid, and riboflavin, as well as for the processing of chemicals that help reduce environmental pollution.

For example, microbes can be used to create bio-fertilizers or to reduce metal pollutants. Microbes can also be used to produce certain non-microbial products, such as insulin, a drug for diabetes [12].

3.4 Viruses

In biology, viruses are specific microorganisms that do not belong to the domain of eukaryotes or prokaryotes, possessing a pathogenic capacity: they can cause diseases and catch up by contagion. To develop and multiply, the virus needs a host cell (living cell). By penetrating the latter, the virus behaves like a parasite by harming it and using it to live.

The virus hijacks the functioning of the cell to produce its own genetic material and no

longer that of the host [13]. The high cell produces "new virions" that will respond in the organism. These parasites in turn will infect other cells. Once the virion (infectious viral particle that consists of a nucleic acid (DNA or RNA) surrounded by a protein and sometimes lipid envelope, the capsid, consisting of many copies of one or more types of proteins) infects a cell, it becomes a virus.

This is the phenomenon of intracellular micro-parasitism. Therefore, the more virions produced, the more opportunity they have to spread in the body and the more cells they will infect, thus causing a so-called infectious disease. The damage or death of a large number of parasitized cells leads to the person's illness and the appearance of symptoms. Viruses come in many forms because of the capsid (protein envelope) that surrounds them. There are four known forms of virus: rod, polyhedral, membranous and caudal polyhedral. The following figure summarizes them.

Viruses can infect all types of organisms (vertebrates and invertebrates, plants, fungi, bacteria, archaea) [14]. Prevention and treatment of viruses depend on the disease. For prevention, vaccines have been developed so that the body is prepared to defend itself against infection. For treatment, drugs called antivirals exist today.

Several didactic works have alluded to the abusive use of antibiotics in viral infections. In fact, the antibiotic has no effect on the virus, except in the case of bacterial superinfection. Because these two entities "virus and bacteria" are not the same. However, they are discussed in the 1st year school textbook, in the subject of this research, as being microbes.

3.5 Bacteria

Bacteria belong to the domain of prokaryotes and the kingdom of monemes:

they are simple cellular organisms that do not contain nuclei. They can have different shapes: Cocci (sphere), bacilli (rods), spirals or pleomorphs (ability to change shape). The arrangement (how they are placed when they are several together) of these also varies, going from isolated, in pairs or in colonies. The arrangement of the bacteria is used among other things to identify the species.

Bacteria are also found in our environment and in our bodies: they are called holobionts [15]. In fact, these bacteria are not all dangerous and some of them are even beneficial for us and can help us for example in the digestion of food and also in the recycling of waste. Some of the foods we eat contain bacteria, such as yogurt, yeast, etc.

Bacteria that cause disease are called pathogens. When bacteria manage to adhere to a human or animal tissue (the intestinal flora) to grow, they cause the symptoms of a disease.

The body's defense system comes into play and intervenes against these harmful bacteria. If the bacteria is fought, no symptoms related to the disease appear. But, if the bacteria manages to invade our tissues, symptoms will appear. In this case and to treat a disease caused by bacteria, it is necessary to take drugs called "antibacterial".

3.6 Health education

It is within the framework of health education that the student, a future enlightened citizen, is supposed to learn to preserve his or her health and that of others, but what do we mean by health education and on what basis does it rely?

Health education is, as Cardot [16] points out, a concept that is "difficult to define because there is no unambiguous definition, which is why the first obstacle, when

working on health education, is to delimit its field, its contours, to define it in such a way as to get out of the vagueness that can arise around it. Not every educational act is health education, since health education is a part of general education, which is above all oriented towards well-being; it aims to enable people to feel good in their own bodies and with others.

Jourdan [17] explains that the legitimacy of health education should not be linked primarily to health problems, but that it should promote the construction of skills enabling the individual to make informed and responsible choices. It is therefore a matter of offering individuals the means to take care of themselves, to make autonomous and reasoned decisions and to exercise responsibility for their own health. Therefore, health education could take its place within the "education to ..." (health, environment, safety, etc.) which are non-disciplinary school forms [18].

The WHO (Thirty-sixth World Health Assembly, 1983) defined it as the set of information and education activities that encourage people to want to be healthy, to have access to the know-how to achieve it and to do what they can individually and collectively to maintain their health.

Like the school, the role of the family is important and even central in the processes of health and citizenship education of future citizens. It is necessary to promote debate, transmit values and opinions and learn practices in order to acquire knowledge, behaviours favourable to their health and skills that promote the development of a relationship to health and citizenship.

The two main models that help define the concept of health are the biomedical model and the health promotion model. In the case of the first model, health is understood as the absence of disease and is defined as an organic problem, whereas in the second

model the focus is more on the preventive dimension.

In this context of the Covid-19 pandemic, the citizen is responsible for its transmission. Since in the absence of preventive measures and the respect of the sanitary protocol, indicated by the WHO, such as distancing, wearing a mask and vaccination, the virus circulates more easily.

Health promotion encompasses three dimensions according to Downie et al [19]: health education, prevention and protection. Health education seeks to improve the level of health of individuals and communities based on two dimensions. One is prevention, which is considered a negative dimension, and the other is protection as a positive dimension, which is able to act to achieve good health and well-being, as shown in the following figure.

3.7 The concept of conception

Our research proposes to explore students' conceptions of Pandemic Covid 19 and it is to this end that it is essential to explain this important concept in science didactics.

Conceptions were initially designated by the word "representations" (not to be confused with "graphic representation", "theatrical representation"...) imported from social psychology which initially represented the ideas that students might have about a given concept. From a didactic point of view, Migne was among the first to introduce the term representation: "a representation can be considered as a personal model of organization of knowledge in relation to a particular problem ... the difference between representation and scientific concept is not a difference of degree, but they constitute two distinct modes of knowledge" [20].

Indeed, Clément [21] specifies that: "it is in the context of constructivism that science educators were very early interested in "common sense reasoning" that they called

"spontaneous representations", "initial representations", "naive conceptions", "alternative conceptions", "misconceptions", etc. Giordan and Martinand (1988) already noted dozens of synonyms. Their number has since increased".

In addition, it has been used to designate the "conceptual déjà-là" that Astolfi spoke of "the idea of representation of a concept. The starting point of the idea of representation has become classic since the work of Bachelard, Piaget, Bruner... It is that all learning interferes with a conceptual 'déjà-là' which, even if it is scientifically false, serves as effective and functional operating systems for the learner." [22].

In 1994, Giordan [23] suggested replacing the term "representation" by the concept of "conception". The latter is used by educationalists thereafter.

Moreover, "The learner's conceptions may depend on his personal history (Giordan & De Vecchi, 1997), or on the socio-cultural context in which he lives and evolves, on his degree of maturation (Piaget, Inhelder, 1992), on the teaching he has received, but also on the relationship he has with knowledge." [24]. Experiences, social and environmental factors can influence the child's thinking and therefore his learning.

In fact, these conceptions or intellectual constructs, according to Morin [25], will be at the origin of certain attitudes, such as the obligation to wear masks, vaccination and the respect of sanitary measures related to the Covid-19 pandemic.

Following this overview of the notion of conception, we can say that conceptions are an already existing on which learning is built. They can be individual or collective. In the latter case, we speak of social representations. They can be resistant, as they can be tainted by certain beliefs. They

guide our attitudes and our decision-making. Hence our choice of our experimental framework, within the framework of Covid-19.

4. Research methodology

The questionnaire consists of 23 closed, open and semi-open questions, depending on the purpose of our research.

The questionnaire was asked in French since SVT is taught in French, but the students were free to answer in Arabic or French.

In this research we begin by characterizing and analyzing the conceptions related to the concepts: virus, bacteria and coronavirus of the Tunisian pupils of the secondary school after teaching of the chapter "microbe and health" in SVT in order to see the contribution of the teaching on the circumstances of the current coronavirus: information, prevention and hygiene, degree of integration of mode of "the promotion of health" at the pupils and the declared behaviors of the pupils made with the coronavirus.

This protocol has four parts composed of a number of questions. These parts are:

- How do students explain the origin and identity of the coronavirus?
- How do they explain the routes of contagion?
- What are their practices to the hygiene measures?
- What are the means of prevention and treatment against Covid-19?

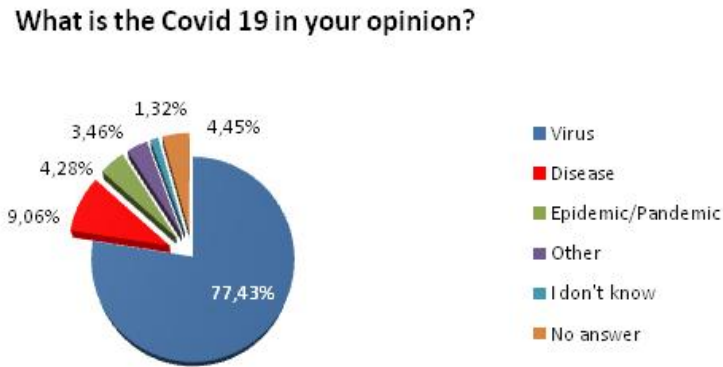
The analysis of the students' conceptions [26] was done by assembling the students' answers according to their lexicon, which carries meaning, in order to classify them into categories and sub-categories.

5. Analysis of results and discussion

5.1 Students' Conceptions of the Covid-19

In this section we asked students about the nature of Covid 19. The following figure summarizes what they said:

Figure 1 : Fig. 1. Graph of analysis of students' responses on the Covid-19 presentation



The broad categories of responses identified are in descending order:

- 1) Virus with 77.43% of responses
- 2) Disease with 9.06% of responses
- 3) Epidemic/Pandemic with 4.28% of responses

Other responses that cannot be categorized due to their small number are also identified.

The results of this first part of the questionnaire show that most of the students interviewed classified the coronavirus as a virus. Some students qualified the virus by: dangerous, deadly, pathogenic... others accompanied their choice with comments concerning the action of the virus as: "...which attacks the lungs of the human being" or its origin as: "...manufactured in a laboratory, international". This qualification can be due to the fact that the current coronavirus is unknown in the whole world. The latter was responsible for the saturation of the hospitals and a very high number of deaths.

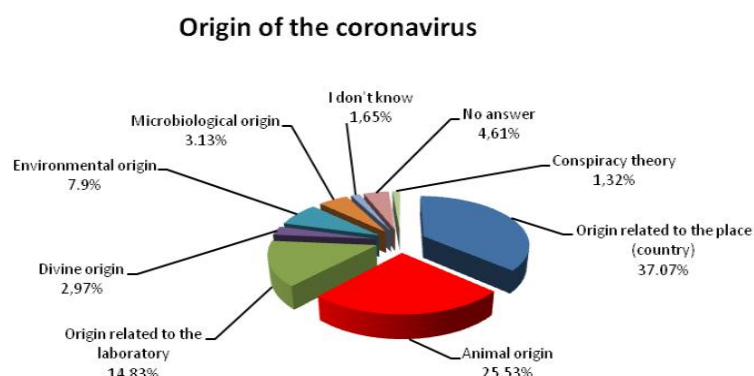
The WHO [27] stated, when talking about the ongoing pandemic, that the coronavirus disease of 2019 is called COVID-19 and that coronaviruses are a family comprising a

large number of viruses that can cause a wide variety of diseases in humans (variants). Nevertheless, students answered the question about Covid-19 as a coronavirus (virus). This allows us to see that there is confusion between the concept of "coronavirus" and the concept of "Covid-19" among the students surveyed (77.43%). This could be due to its common name in the media.

5.2 The origin of the Covid according to the students

The graph below shows the conceptions of students surveyed about the origin of Covid-19:

Figure 2 : Fig. 2 : Graph analyzing students' responses on the origin of the Covid-19



The most repeated answers of the students about the origin of the coronavirus were related to the place (37.07%).

Almost 15% of the students marked in their answers that the research laboratories are responsible for the appearance of the coronavirus. In fact, this is a hypothesis announced by the media and retained by many people. We find here traces of the register of the conspiracy theory.

Also we have almost 3% of the total sample who have conceptions belonging to religious registers [28]. Thus, many students think that it is a divine punishment [29].

The conceptions of the students could be influenced by the information disseminated in the media, especially in social networks (e.g. by watching videos about the Chinese diet and associating it with the existence of corona)...

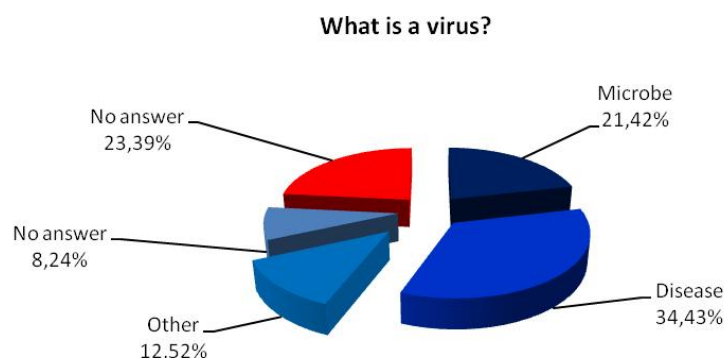
Indeed, we did not notice the impact of the teaching on the students' conceptions and we could only see that of the media and the society.

5.3 Students' conception of the concepts of bacteria and virus

Microbiology is a subject that is encountered at school but also in everyday life and through the media. The students' conceptions of bacteria and viruses would not be neutral but would be influenced by information transmitted by society and the media. These conceptions would be crossed with the knowledge acquired at school.

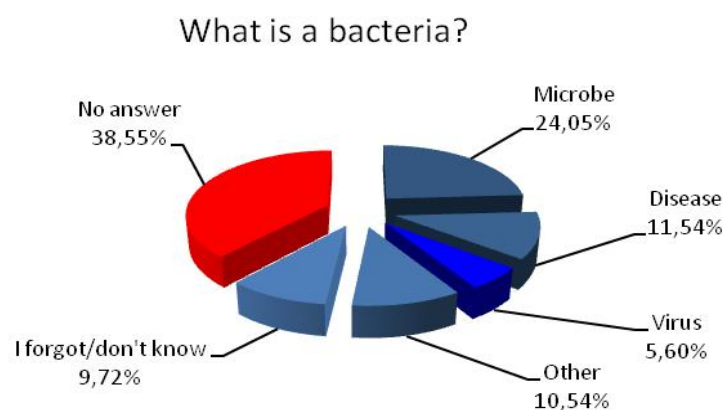
Concerning the notion of virus, the results are distributed as follows:

Figure 3 : Fig. 3: Analysis chart of students' conceptions of the virus



Concerning the concept of bacteria, the results can be found in the following figure:

Figure 4 : Fig. 4: Analysis of students' answers about the bacteria



The analysis of the two figures 3 and 4 shows that the percentages of the categories are more or less close. That is, there is not a big difference between them.

Comparing the same categories of the two questions, we find some differences such as the category "immunity" which is found in the answers to the question on the virus and is absent in the question on the bacteria.

In order to introduce the virus or the bacterium, there are students who simply cite an example of a microbe.

A significant number of students do not answer the previous two questions. Sometimes they answer only one question. This could be due to a lack of information or to a difficulty in answering open-ended questions (did not want to make an effort).

At the conceptual level "microbe", "virus", "bacteria" there are gaps, hence the confusion between these concepts among the students interviewed.

The impact of teaching: the answers of some students are influenced by their learning (using scientific terms).

Course impact and sources of information: the formal and the informal

The questions asked in this section are intended to see the impact of formal learning (coursework) and informal learning (other sources of information) among students in Covid-19.

Our results are illustrated in the following figures:

Figure 5 : Fig. 5 : Impact analysis of the Covid-19 course

Have you taken a course that can tell you about the coronavirus?

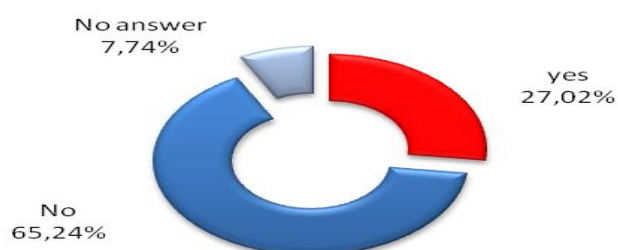


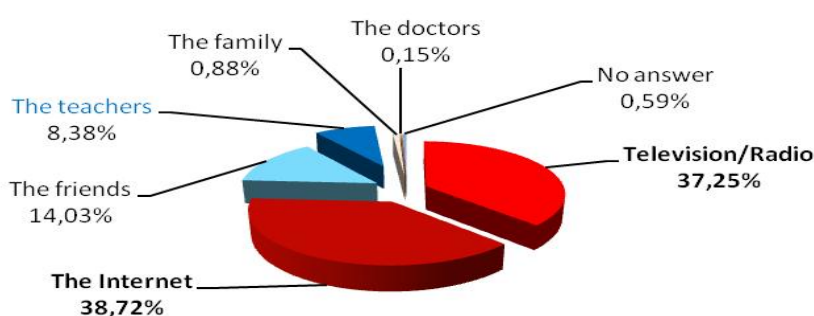
Figure 6 : Fig. 6: Analysis of student responses to the course on viruses and bacteria

Have you taken a course dealing with viruses and bacteria?



Figure 7 : Fig. 7: Analysis of students' responses about their sources of information

What are your sources of information about Covid19?



Our results show that the media have a very important impact on young people, who increasingly believe in information disseminated on the Internet [30]. The students in our sample admit that it is the most important source of information for them.

Students do not make the connection between the formal and the informal. In other words, what comes from teaching and what comes from their experience.

The impact of teaching: Some students' responses are influenced by their learning.

There is a discrepancy between the existing title in the textbook (microbe and health) and those actually proposed in class, and they lack the concept of health.

5.4 Covid-19 prevention practices and measures

The pandemic, in terms of knowledge, is under construction: we have undergone all types of uncertainties, as to its origin, its manifestation, its virulence and especially its modes of transmission. Several health protocols are proposed as measures of care, several confinements that have even changed the face-to-face teaching in distance learning.

Hygiene is one of the processes to prevent the transmission of coronavirus. The Covid-19 pandemic caused a sanitary crisis, so it was necessary to practice a sanitary protocol in order to avoid the contamination and the spread of the virus [31]. Decreed by the

majority of the countries of the world, a state of sanitary emergency imposed the confinement of the people. Similarly in Tunisia, the state has imposed the confinement during several periods of the important spread of the virus and a local sanitary protocol conforms with that announced by the WHO. Therefore, all the establishments have required the sanitary protocol as a preventive measure against Covid-19.

The purpose of these questions is to analyze students' conceptions of their Covid-19 prevention practices and measures as shown in the figures below:

Figure 8 : Fig. 8: A Analysis of student responses on practices and actions against Covid-19

How to protect yourself against the coronavirus (at home, at school, in closed or open spaces ...)?

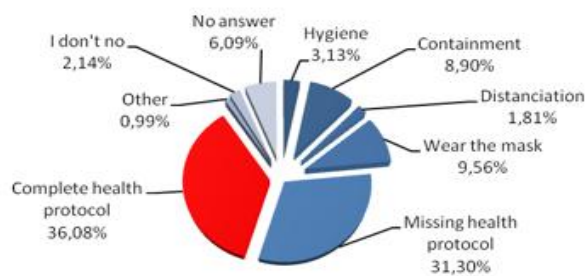


Figure 8 : Fig. 9: Analysis of students' responses on the routes of transmission of coronavirus

By what route(s) of transmission does the coronavirus become infected?

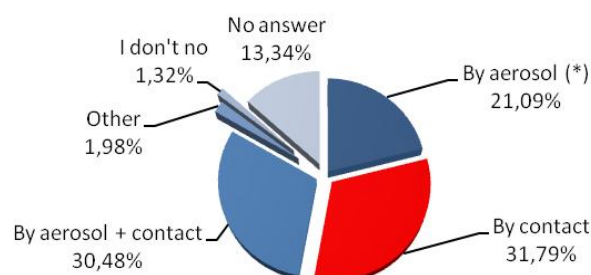


Figure 9 : Fig. 10: Analyse des réponses des étudiants sur les voies de transmission du coronavirus

To protect yourself from Covid-19, add to your meals

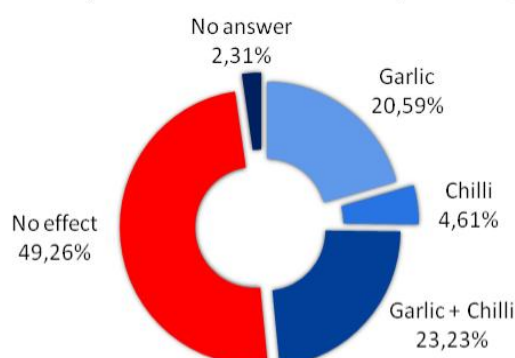


Figure 10 : Figure11: Analyses of students' responses about the existence of a medication for the treatment or prevention of Covid-19

Is there a medication for the treatment or prevention of Covid-19?

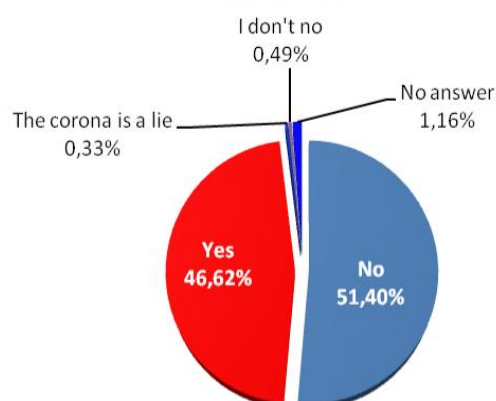
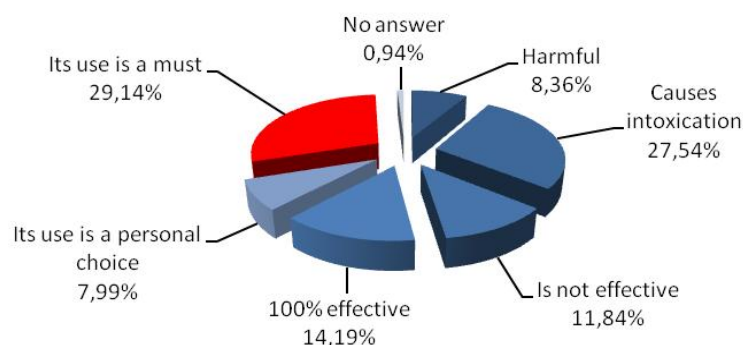


Figure 11 : Fig. 12: Analysis of students' responses on the use of masks in coronavirus prevention

The use of masks in the prevention of coronavirus



In the answers of the students, there is existence of the common sense and the

popular and religious register. The media and especially the Internet or the

students' environment influenced their conceptions.

In spite of the existence of the course "Pathogens and infectious diseases", we do not see in all the students' answers a scientific argumentative spirit.

In the students' answers there is a weak structure of the answers in French and sometimes even none (written in Arabic).

The role of the school is absent in the promotion of health, relative to the Covid context.

6. CONCLUSION

This study on conceptions shows that students who are supposed to have studied the concepts of viruses, microbes, and vaccination are not immune to conspiracy theories and religious or other myths about Covid 19. This is obviously due to the media and also to the Internet which makes these conceptions more visible and facilitates and accelerates their mass propagation. For this reason, more attention should be paid to media education in the different levels of education to avoid indoctrination and to build an informed and reasoned point of view and to make the student vigilant to information and sources.

We also need to work on critical thinking to combat myths and pseudoscience. Understanding and thinking critically is a crucial skill in the modern world. Critical thinking education should really be part of the school curriculum well before university as it takes time and various trainings. It should clearly help to distinguish between science and pseudo-science [32] in order to give the learner a life skill to become a good citizen.

Schools are seen as places for health education and health promotion, but the main activity of schools is actually focused on academic achievement and not on reducing health problems. In most countries, schools give low priority to health promotion, and school staffs (mainly teachers) are not aware of their role in health promotion. Studies show that teachers who have received training in health promotion tend to be more frequently involved in health promotion projects and have a more holistic approach to health education [33]. For this reason, teacher training in Covid and "Education for..." seems necessary and mandatory...

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