WHEN SCIENCE GOES VISUAL

SCIENCE COMMUNICATION ON YOUTUBE AND TIKTOK

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CHAPTER 1
INTRODUCTION

In a time of fast and deep changes it is vital to stay up to date. This is mainly true for teachers and communicators who must relate to the new generations of students. Traditional teaching methods – based on lectures and memorization – are not enough to stimulate their curiosity anymore. In particular, science education needs to adopt new strategies in order to promote a more positive attitude by young people towards science.

It is against this background that Pleiadi steps in.

Pleiadi Science Farmer is one of the most important Italian societies involved in the science educational field. This group is characterized by a vocation for innovation and it is always looking for new ways to improve science communication. The project WHEN SCIENCE GOES VISUAL represents one of its latest initiatives, performed in association with its franchisee PopBrains. It is part of a wider process aimed at finding new ways to communicate science by means of visual contents, rather than live events, distributed through social media.

The project consists of 4 video tutorials and at least 4 shorter videos which are going to be published on YouTube and TikTok, respectively, targeting kids between 8 and 12 years old. Each video includes several simple experiments which can be easily reproduced by the viewers at home.

The combination of theoretical explanation and practical demonstration allows Pleiadi to present basic scientific topics in a more effective and appealing way.

YouTube and TikTok represent two of the most popular social media and video sharing platforms among young people, potentially providing high visibility to Pleiadi's contents. While many communicators and teachers already use YouTube, TikTok is still quite new to science communication and education. One of the best qualities of this platform is the possibility to reach a very large and varied audience, thanks to its peculiar video content delivery system.

After the project is complete, the videos' performance is going to be monitored to identify possible improvements.

CHAPTER 2
WHO ARE PLEIADI AND POPBRAINS

Pleiadi Science Farmer is a science communication society founded by Alessio Scaboro and Lucio Biondaro, in 2009. One of the most innovative Italian societies in the field, Pleiadi organizes scientific events, exhibitions, and school activities mainly aimed at children and families.
The philosophy behind this group is to stimulate kids'curiosity by involving them in practical activities rather than simply disseminate theoretical knowledge. This concept is perfectly represented by one of their slogans: "Imparare con le mani" (learning through hands).
Pleiadi's innovative teaching method – called Elaborazione Logico Sperimentale (ELS) – consists of an interdisciplinary approach, deeply connected with the world of scientific research. Kids are given a topic to analyze together with an explainer, starting from the basic concepts and then moving to the more complex ones. The explainer's task is to help them reflect to find a solution independently, instead of simply giving them the answer.
ELS offers significant benefits compared to traditional teaching methods. First of all, it promotes the use of imagination to apply previous knowledge in new, creative, ways. Moreover, it helps kids develop critical thinking and teach them how to overcome difficulties through logic and experience. This way, Pleiadi wishes to increase the passion of the youth for science, while giving it useful tools to face the challenges of tomorrow.
Pleiadi's success can be seen in the figures: only in 2017, 250 thousand people among schools, events, and exhibitions participated in the group's activities. Moreover, the society is not only nationally renowned, but has gained an international reputation. Recently, Pleiadi globally published "Guida galattica al coronavirus" – a brief guide about the COVID-19 pandemic – with great success.
The book was created in association with PopBrains snc - the first Pleiadi franchisee - which shares its spirit of innovation.

Founded in 2015 by Erika Nerini and Daniela Longo, the company works with Pleiadi on Edutainment activities, using logic, interaction, and experimentation to disseminate knowledge among the youth. Moreover, PopBrains snc is specialized in Medical Writing and scientific communication in the healthcare sector. Therefore, it was possible to include in the project WHEN SCIENCE GOES VISUAL highly topical subjects, such as the current Coronavirus outbreak.
Erika Nerini and Daniela Longo personally supervised the project, offering their knowledge and experience in each of its phases.

CHAPTER 3
WHAT IS YOUTUBE

DID YOU KNOW?
With over 15,7 million subscribers, Vsauce is one of the most popular science communicators on YouTube.

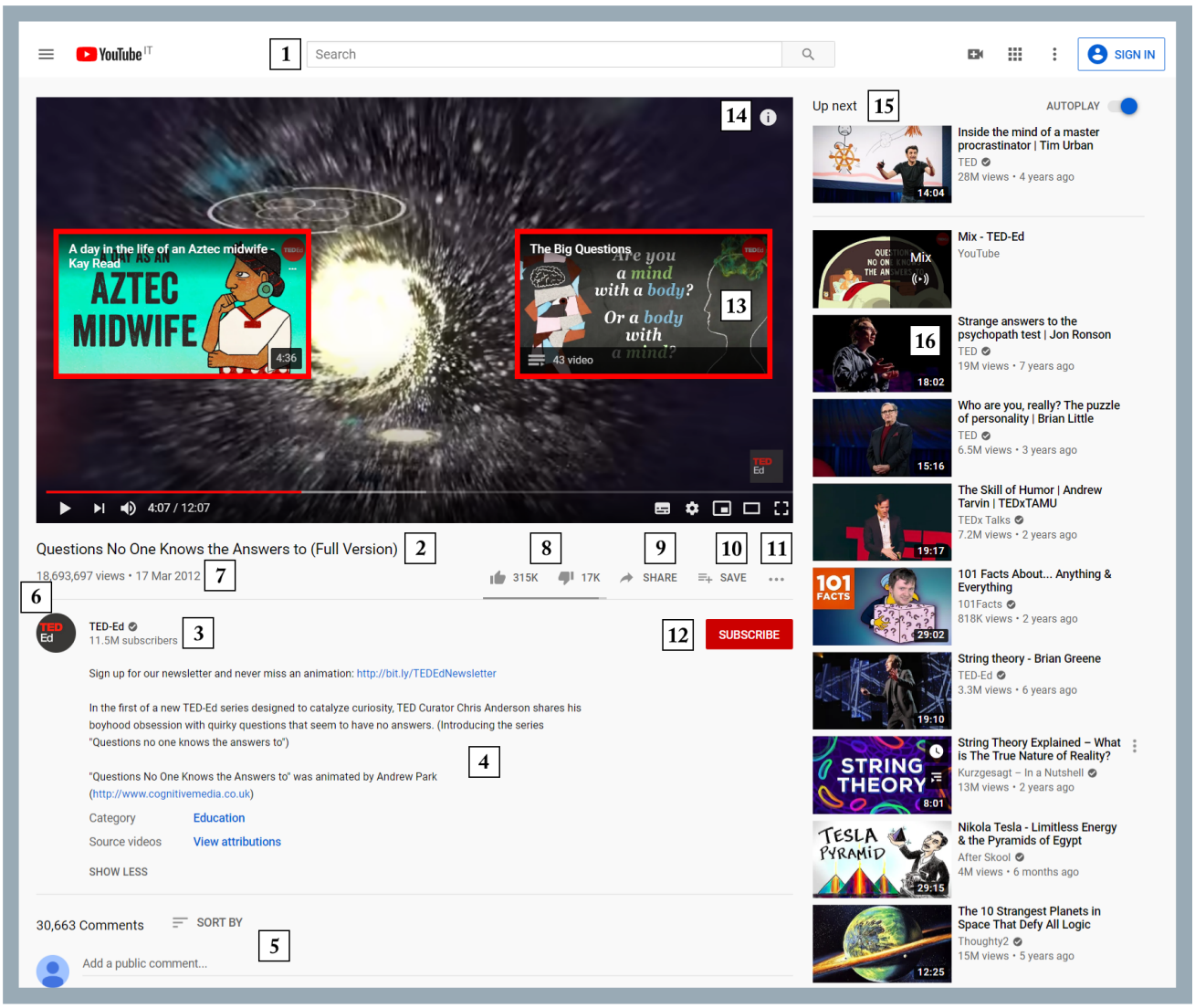
YouTube is an online video sharing platform founded on February 14, 2005 by Steve Chen, Chad Hurley and Jawed Karim. It allows users to freely upload videos with different runtimes, from a few minutes up to several hours, on personal channels. Most videos are free to watch while others require premium subscription. YouTube is an extremely rich online video library providing any kind of contents, from music to video tutorials. Moreover, it is endowed with several social features allowing users to interact with each other.

3.1 - YouTube and kids

This platform is very popular among people of any age, including kids. For this reason, a new app – called YouTube Kids – was released in 2015. This platform offers parents a family-friendly environment, allowing them to have more control on what their children watch. It is possible to choose among three different settings: Preschool (Ages 4 & under), Younger (Ages 5-7) and Older (Ages 8-12), offering a selection of videos appropriate to each age range. Parents may also personally choose which videos can be watched by their children. In any case, comments are disabled to avoid inappropriate contents.

3.2 - YouTube and science

Science communication and education are a well-established reality on YouTube, which represents one of the most popular sources of scientific contents on the Internet. Some of them are produced by renowned institutions, such as National Geographic, while others come from personal channels. These may belong to scientists or even amateurs who, nonetheless, may publish extremely valid videos. So called Science YouTubers may use very different formats, from vlogs to animations, and usually adopt a very personal style. Some of them use pop culture elements to present scientific topics in a more attractive way, while others prefer more traditional approaches.



1- SEARCH BAR: find videos through keywords
2- TITLE: it identifies the video's content
3- CHANNEL'S NAME and NUMBER OF SUBSCRIBERS
4- DESCRIPTION: to include additional information (e.g., a summary of the video's content)
5- COMMENTS SECTION: allows viewers and creators to leave comments
6- VIEWS: counted every time an user clicks on PLAY and watch the video for at least 30 seconds
7- RELEASE DATE
8- LIKE/DISLIKE: to evaluate videos
9- SHARE: to share videos on other platforms
10- SAVE: to add videos to a personal playlist
11- MORE FUNCTIONS: e.g. REPORT when videos contain inappropriate contents
12- SUBSCRIBE: allows users to subscribe to the channel and stay updated on the latest videos
13- END SCREENS: same functions of cards, but they only appear within the last 20 seconds of the video
14- CARD: allows creators to promote videos, channels, websites…
15- UP NEXT: a list of suggested videos based on the user's preferences
16- THUMBNAIL: visual icon identifying the video's content

THE RESEARCHER'S CORNER

Superior economical resources do not grant popularity on YouTube. A research by D. J. Welbourne and W. J. Grant (2015) shows that viewers prefer science channels they perceive as reliable sources, even if they belong to private users instead of famous institutions. Trusted sources are identified from several elements, including the communicator's impartiality and affinity with the audience. Therefore, user-generated science channels may be even more popular than professional ones.

CHAPTER 4
WHAT IS TIKTOK

DID YOU KNOW?
Science communicator Nick Uhas produced one of the most popular TikTok videos ever, with almost 19 million likes and over 265 million views.

TikTok is a social video platform created by developer ByteDance and originally launched in China on September 2016, by the name of Douyin. The application is free and allows users to upload short videos (3 to 15 seconds, or up to 60 seconds) on their profile. These contents are typically combined with music, filters, and effects. What is unique about TikTok is its video content delivery system, which is based on both manual and automatic recommendation. Therefore, new users do not need to follow accounts and may start immediately watching every kind of contents, from funny to educational videos.

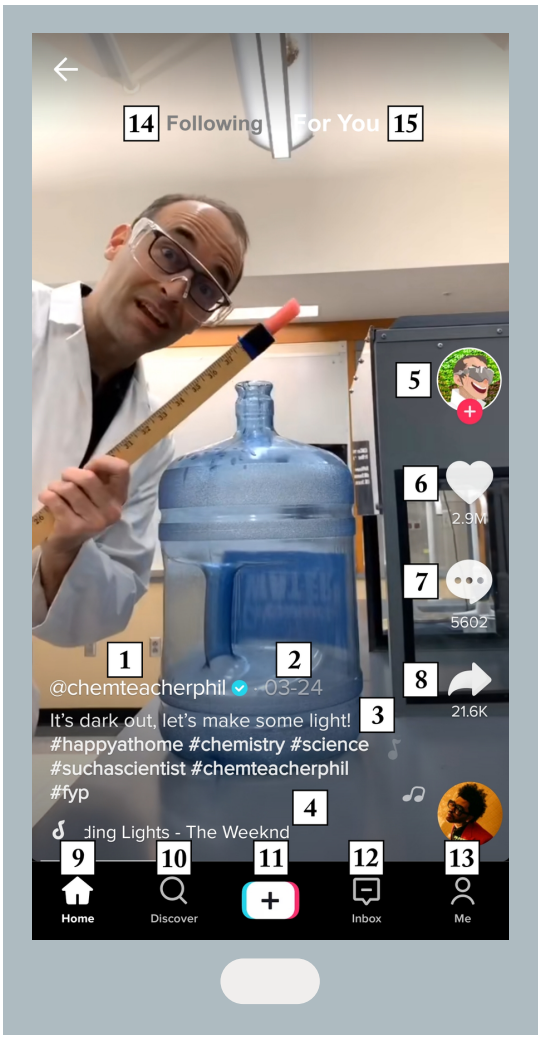
4.1 - TikTok and kids

Despite it has been active for just a few years, TikTok already enjoys great popularity with people of every age, especially young people (teens and kids under 13 years old). Its success partly lies in the videos' short runtime which perfectly fits new generations' tastes, allowing them to watch more contents in less time.

Another popular feature is the so-called challenge: this is typically a combination of text, music, and choreography, where creators ask viewers to mimic them. They represent a powerful tool to promote public engagement and to increase the video's visibility.

4.2 - TikTok and science

TikTok has caught the attention of not only young people, but also of scientists. Science communication is, in fact, a rapidly growing phenomenon on the platform, with many researchers (e.g. Neil deGrasse Tyson) and even renowned institutions (e.g., WHO) having already joined the community. Many of them see TikTok as an opportunity to reach a large audience (especially young people) and to convey a more humanized and positive representation of scientists. Science TikTokers produce a wide variety of different contents: some, like chemistry professor Phillip Cook, perform science experiments in lab, while others, such as Dr. Nicole Baldwin, fight science disinformation through music and dance.



1- USERNAME
2- RELEASE DATE
3- DESCRIPTION: to include additional information and hashtags (use to categorize the video's content)
4- SOUNDS: music or dialogue, either from the TikTok platform or uploaded by the creator
5- FOLLOW: to follow the account and stay updated on the latest videos
6- HEART: equivalent to likes, allows viewers to evaluate videos
7- COMMENT: to leave comments
8- SHARE: to share videos on other platforms
9- HOME: redirect to Following or For You
10- DISCOVER: to look for new contents through the SEARCH BAR or the suggested videos section
11- +: to upload a new video
12- INBOX: to view notifications (e.g., private messages from other accounts)
13- ME: to access the personal account
14- FOLLOWING: to watch videos from followed accounts
15- FOR YOU: to watch suggested videos

THE RESEARCHER'S CORNER

In China, Provincial Health Committees (PHCs) has started using TikTok as an effective tool to engage with citizens and inform them about health-related issues. According to a research by C. Zhu et al. (2019), Chinese health committees has gained almost 200 thousand followers and more than 1 million likes. Apparently, cartoons and documentary-like videos are among the most viewed, while textual and oral presentation are preferred for information about specific drugs and diseases.

CHAPTER 5
THE PROJECT

The objective of the project is to employ YouTube and TikTok, two of the most used social media platforms, as learning tools to effectively communicate science. The main target is represented by people from 8 to 12 years old, who regularly use both platforms. The project also aims at stimulating the passion of young people for science and helping them develop several important skills, such as critical thinking.
The project may be useful for teachers too, in fact the video tutorials could be used to show them how to effectively employ hands-on activities during science lessons.
The project consists of two parts:

- To design 4 educational video tutorials to be published on YouTube

Each video deals with a different scientific topic (GERMS, KARSTIFICATION, EARTHQUAKES, PLANES), which is explained in an entertaining but accurate way through both a theoretical and practical approach. The latter includes simple, hands-on, science experiments which can be easily reproduced at home. The videos are going to be published on the PLEIADI – Science Farmer YouTube channel.

- To design at least 4 short videos to be published on TikTok

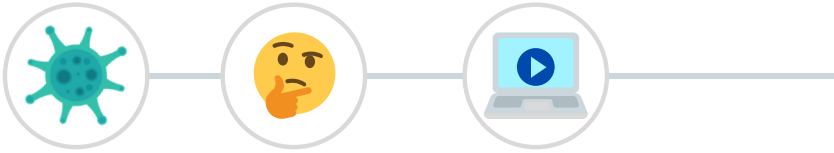
The main purpose of these videos is to increase the visibility of the YouTube video tutorials by exploiting the extreme popularity of TikTok, especially among young people. Once captured the viewers'attention, they will be redirected to the PLEIADI's YouTube channel. These videos are going to be published on the newly created PLEIADI – Science Farmer TikTok profile.
A promotional campaign has been planned to be released in conjunction with each video, on the social media profiles of both
Pleiadi (Facebook and Instagram) and PopBrains (Facebook).

5.1 - Alternative project

It is possible that the project's results differ from what was planned. For example, viewers may appreciate the TikTok videos without visiting Pleiadi's YouTube channel. In that case, we could consider the possibility to produce educational videos for TikTok.
We may publish two (or more) videos a week:

the first one would explain theoretical concepts, while the next one would show how to perform a simple experiment related to the previous video. Depending on the covered topics, both videos may last up to 1 minute. Of course, we should carefully choose theoretical concepts and hands-on activities, so that they may be explained/performed in a very short amount of time. This is especially true for the experiments, which need to be clearly shown so that viewers may reproduce them.
Moreover, we could also produce so-called "science pills", very short (around 15 seconds) and attractive videos about interesting and curious scientific facts. These would represent an effective way to catch the viewers'attention.

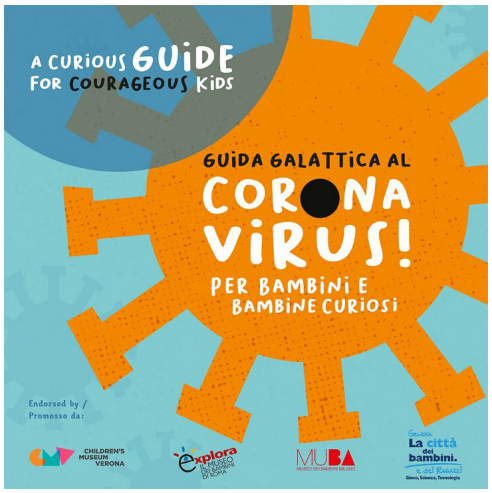
5.2 - Good practices during the COVID-19 outbreak



Soon after the start of the project, additional measures were taken to contain the COVID 19 outbreak in Italy, leading to the closure of the PopBrains'offices, where I was working. Therefore, I had to adopt some practices to continue the project from home.
I autonomously performed researches for useful information and contents on the Web. Moreover, I designed scripts, animations, and experiments for the videos, which were tested at home and thoroughly documented with photos and videos. All the material was regularly uploaded on Google Drive to be checked by Erika Nerini and Daniela Longo. Then, we discussed on Google Meet about possible improvements and changes.

CHAPTER 6
SIDE PROJECT

Before dedicating myself to the project WHEN SCIENCE GOES VISUAL, I had the opportunity to participate in the production of "Guida galattica al Coronavirus" (in English, known as "A curious guide for courageous kids"). This project was launched by Pleiadi in response to the spread of the COVID 19 disease, to inform kids about the current situation.
Through colorful drawings and an easily understandable language, the guide goes through the SARS-CoV-2 discovery and the effects of the disease. Moreover, it explains the importance of following a list of healthy habits to limit the virus spread, such as frequently washing hands with soap. But, most importantly, the guide is meant to help children to keep a positive attitude despite the emergency, without giving in to fear.
The COVID 19 outbreak represented a major challenge for Pleiadi, a group founded on interaction and hands-on activities. Nonetheless, we took the opportunity to carry out a project to help both parents and children to face a new, mysterious, threat. The booklet was very appreciated and became an



international success, which was translated into more than 30 languages. Several Italian schools (e.g. IC3, in Modena), and even foreign countries (e.g. Indonesia), adopted the guide as an effective educational tool for children.
The project is a combination of traditional and innovative methods. In addition to the booklet, the Children's Museum Verona produced a video reading, while the software house PubCoder released an interactive book. I also participated in the production of a press release about the guide, published on "Medici Oggi", a magazine by Springer Healthcare. This way, I had the chance to acquire experience on different types of science communication.

CHAPTER 7
NEW GENERATIONS OF STUDENTS

The idea of publishing educational videos on YouTube and TikTok comes from a detailed analysis of our target's characteristics. Every generation represents in fact a new challenge for educators and communicators, which requires tailored strategies.
The project targets people born between 2008 and 2012. Therefore, they belong to the so-called Z (1995-2009) and alpha generations (2010- present), both characterized by a remarkable familiarity with smart devices and social media. This is particularly true for the alpha generation, whose members did not simply grow with such technologies but were born in a highly connected world [B1, S11].
Of course, this had a significant impact on how they prefer to learn. They are usually not quite satisfied with traditional teaching methods, involving listening to lectures, taking notes, and memorizing information . They expect to learn through personal experience, performing hands-on activities, and will frequently exploit their familiarity with modern technologies to search for instant information on the Web [B1].

7.1 - Videos and social media

One of the most popular online sources of (scientific) knowledge is represented by YouTube. Although it was originally intended as a way to share simple, home-made videos, YouTube is now an extremely rich video library featuring a wide variety of contents, including educational ones. This is one of the reasons why it is so popular among young people (and not only), who use it both for entertainment and learning.
Compared to traditional lectures, YouTube videos feature several characteristics which are much appreciated by young people, such as the possibility to watch them when and where they like. In fact, viewers may access the platform from almost any kind of smart devices (PC, smart TV, smartphone…) via website or app. Today this is particularly true thanks to the near-universal presence of mobile devices, which are regularly used even by very young people.
Moreover, young people usually find it easier

to learn by means of visual media rather than oral lessons. It is not just a matter of taste: some studies show how their brain development has been deeply influenced by the highly technological environment in which they grew up. In fact, it is very efficient in processing complex visual data, making auditory learning proportionally less effective [B1].

In addition to YouTube videos, the project WHEN SCIENCE GOES VISUAL includes the production of contents for one of the most popular social media at the moment: TikTok. The brief and catchy videos shared on the platform meet the short attention span characteristic of new generations, which partly explains why it is so popular among young people [S26]. Therefore, TikTok offers the possibility to reach a large, young audience, giving more visibility to the related YouTube video tutorials.

Despite its qualities, TikTok also has some limits. In particular, the very short video format makes it a less suitable platform for video tutorials, compared to YouTube. Moreover, YouTube allows viewers to rewind videos, which is extremely useful in case the viewer missed some passages.

7.2 - Simple experiments

Traditional teaching methods impose a passive role on students, who are expected to accept a preconstituted knowledge from the teacher, and to reproduce it during examinations. This may demotivate students, leading to a dangerous lack of interest towards the covered topics [S24].

In accordance with Pleiadi's philosophy, the project WHEN SCIENCE GOES VISUAL prefers a more dynamic teaching method, supporting theoretical explanations with hands on activities. The latter consist of so-called simple experiments, characterized by easy and safe execution, ease of understanding, and the use of everyday materials. Therefore, viewers will be able to easily reproduce them at home, while watching the video tutorials.

Simple experiments represent a powerful tool to stimulate young people's interest and curiosity and may also have benefits on their education. Instead of being just listeners, viewers have the possibility to take an active role and "rediscover" the scientific concepts behind the phenomenon. This way, hands-on activities promote the development of important skills, such as problem solving and critical thinking, while traditional methods mainly favor memorization abilities [B6, S18, S23].

Another unique feature of simple experiments is that they combine different sensory channels: auditory (dialogues, lectures, readings), visual (pictures, videos, graphs), kinesthetic (practical activities). Several studies indicate that multisensory learning is very effective, possibly because our own brain evolved to operate in natural, multisensory, environments [B5, S17, S29].

Eventually, simple experiments may represent an opportunity to extend science education to

the whole family. While helping children performing the experiments, relatives may better understand some theoretical concepts which, especially for older generations, may be unclear. Thus, they could develop a more positive attitude towards science, encouraging them to actively participate in their child's education (B6).

7.3 - Further considerations

The project's video tutorials stand out from most science videos on YouTube, which may be divided into two groups: those explaining topics from a purely theoretical point of view, and those focusing on hands on activities (at the expense of theory). Moreover, science experiments are often featured on entertainment videos too, which are not interested in explaining the scientific phenomenon behind.

As regards TikTok, science communication still represents an evolving phenomenon compared to YouTube (where science videos are quite common). Therefore, the project WHEN SCIENCE GOES VISUAL offers Pleiadi the opportunity to be one of the first Italian societies exploiting TikTok for education.

In any case, the project could require some time to become really effective.

The number of YouYube subscribers is very important, since they guarantee constant views and interactions with videos, increasing their visibility on the platform. However, Pleiadi's YouTube channel still has few subscribers, and it could be months before they significantly increase. The same goes for TikTok, even if to a lesser extent thanks to its peculiar video content delivery systems. This is a combination of hashtags and both automatic and manual recommendation allowing users to watch a wide variety of contents, including those from accounts they do not follow. Therefore, even if Pleiadi's TikTok profile has just been created, it still could reach a quite large audience from the start, including those viewers who do not usually watch scientific contents.

And what about alternative social platforms? Actually, Pleiadi already has Facebook and Instagram accounts, respectively featuring 651 and 2294 followers.

As for Facebook, visual contents are very appreciated among users, and are considered the most engaging types of posts. Like YouTube, it allows to publish very long videos (up to 4 hours) and to rewind them if needed. However, this platform shows two major flaws: first, it is becoming ever less popular among young people [S1]; second, it features a disadvantageous content delivery system. Without using paid advertising, it is only possible to reach people who already follows the page.

As regards Instagram, it is technically possible to publish videos up to 1 hour long thanks to a separate application called IGTV. However, only 1% of users actually downloaded this tool, while the vast majority prefers to upload pictures and short videos on the regular application [S25]. In this it is similar to TikTok, in fact both

features videos up to 1 minute long. However, Instagram exploits a content delivery system comparable to that of Facebook, making it much less effective to reach a large audience (especially for small accounts).

CHAPTER 8
RESEARCH

The first phase of project WHEN SCIENCE GOES VISUAL consisted of a documentation process aimed to better understand how to create (science) YouTube and TikTok videos. I collected several information from online tutorials (e.g., Filmora) and research articles (Welbourne & Grant, 2015).
Moreover, I analyzed 52 videos showing science experiments or concerning scientific topics (26 from YouTube and 26 from TikTok). The research data are available here.

- YouTube

- both Italian and English-speaking videos
- I Googled "YouTube canali divulgazione scientifica" and "best YouTube experiment science channel" and found "20 canali scientifici da seguire su YouTube Italia" and "The 10 Best YouTube Channels for Wacky Science Experiments", respectively. Here, I found a list of suggested YouTube channels dealing with scientific topics and/or science experiments.
- I performed a search on YouTube using the browser's incognito mode, to reduce interference by search personalization settings possibly affecting the results. I looked for the following keywords: "scienza" - "science", "scienza bambini" - "kid science", "esperimenti scientifici" - "science experiment", "pillole scienza" - "science pills", "esperimenti scientifici per bambini" - "kid science experiment".
- I selected several useful videos from the "Up next" section
- As for SCIENZIATI subito, I was able to trace it back to the original English-speaking channel (AsapSCIENCE)
- I analyzed several more science videos from my subscriptions
- I signed in YouTube kids as PARENT, choosing the "Older" content setting (ages 8-12), and performed a search using "scienza" - "science" as keywords.

- TikTok

- Both Italian- and English-speaking videos
- I googled “scienza TikTok”, finding “La (in)sostenibilità della scienza su Tiktok”, and “science TikTok”, finding “The science community shows off on TikTok”, “TikToks are teaching Generation Z about science”, and “Chemists are finding their place on TikTok”.
- I specifically looked for professionals’profiles by googling “medici TikTok” - “TikTok doctors”, finding “Anche i medici provano a stare su TikTok” and “Doctors on TikTok Try to Go Viral”.
- I performed a search on the TikTok app by means of the “For You” page and the “Discover” section, looking for the following hashtags: #scienza - #science, #esperimentiscientifici - #scienceexperiment.

8.1 - How were the videos selected?

The following criteria were applied in order to select the most appropriate videos:

- I analyzed videos produced by science channels and profiles, which were identified based on their contents: I selected those which regularly deal with scientific topics to teach or inform people (e.g., TED-Ed – Vsauce).
- I included videos produced both by personal and institutional channels and profiles (e.g., Dario Bressanini – National Geographic; Phillip Cook - WHO).
- I included videos targeting different age groups, from adults (e.g., Barbascura; IOHA) to kids (e.g., SciShow Kids; Science For Kids).
- For each YouTube channel, I generally selected the most popular video (according to the platform, the one featuring more views). However, I also included the most popular video featuring scientific experiments from SciShow Kids and Dario Bressanini. As for European Space Agency, I also included the most popular video from the series Paxi – ESA Kids mascot.
- For each TikTok profile, I selected the video featuring more views

8.2 - Acquired data

The analysis of the videos provided information on several parameters: BASIC INFORMATION (e.g., channel’s/profile’s name,video’s title); ANALYTICS (e.g., views, likes); DEMOGRAPHICS (e.g., estimated audience geography).
Data regarding estimated audience geography, average interaction (e.g., likes/views rate), active viewers distribution of time (days and hours) for YouTube videos were acquired by means of the statistic website tool noxinfluencer, which also provides information about estimated audience age and gender. While the latter was not considered relevant, age could indicate which channels (thus, which videos) are preferred by children.
However, data about users under 13 (our target) are not available, so videos (and channels) for young people were identified on

the basis of several characteristics: use of very simple expressions (no jargon); funny and goofy acting; topics appropriate for kids; admission on YouTube Kids. Moreover, some channels openly indicate young people as their main target (e.g., SciShow Kids). The same procedure was applied for TikTok videos and profiles.
The remaining data, including every information about TikTok videos and profiles, were acquired manually.

CHAPTER 9
YOUTUBE VIDEOS

Each video tutorial takes place within a recording studio, where both props and materials for experiments are placed on a table, available to the explainer.
The explainer is a professional figure who describes theoretical concepts and performs practical demonstrations in front of the camera, directly addressing the viewers. This is a very common format on YouTube because it helps to engage the public and create a bond between the explainer and the viewers.

9.1 - The videos' structure

The videos are divided into 5 parts: INTRO, EXPLANATION 1, MAIN EXPERIMENT, EXPLANATION 2, OUTRO.

- INTRO: It is very important to capture the public's attention within the first 15 seconds of the video, therefore this section includes a very short (around 20 seconds) and clear description of the main theoretical concepts and hands-on activities featured in the video. To make it even more attracting, the results of the main experiment may be shown at the beginning (e.g., a collapsing toy building), stimulating the viewers' curiosity.
- EXPLANATION 1 & 2: The explainer describes scientific concepts with an easy to understand but very accurate language, using only the essential technical terms. When mentioned, these terms are also displayed as on-screen text to help viewers comprehend them. Both to stimulate interest and promote understanding of scientific concepts, explanations are complemented by images, animations, and very short hands-on activities, which can be easily reproduced at home. Throughout the video, close-ups are used to draw the public's attention to particularly important topics, or to show details of practical demonstrations.

In EXPLANATION 1, we offer the core information necessary to the comprehension of the main experiment and the laws that regulate it. In accordance with Pleiadi's method, we start by introducing basic concepts (possibly, with the aid of very simple experiments) and

only then we move on to more complex concepts, introduced by the main experiment.
Doing so, the viewer is given all necessary understanding of the subject so that he/she him/her-self may not only comprehend what is happening during the main experiment, but, possibly, even anticipate its conclusion.
Another possibility could be to perform the main experiment first and, once caught the viewer's attention, to explain the phenomenon. However, this option was discarded for two reasons.
First, our target is characterized by a very short attention span and may be distracted by the experiment, paying less attention to the following explanation. Second, it has little educational value since it does not encourage viewers to autonomously understand the scientific concepts and develop critical thinking.
In EXPLANATION 2, we discuss the results of the main experiment and delve into the covered topics.

- MAIN EXPERIMENT: the explainer describes the necessary materials and the correct procedure to perform the main experiment. Generally, the results are shown at the end of this section, however some experiments are completed throughout the EXPLANATION 2 part, to delve into specific topics (e.g., how changing the type of soil may affect seismic waves propagation).
- OUTRO: This brief section is devoted to calls to action, asking the viewers to like the video, leave a comment, subscribe to the channel and visit Pleiadi's social accounts and websites. The outro may also include so-called end screens to redirect viewers to the other video tutorials. Considered our target's age, it may be necessary to set the video tutorials as "made for kids"; in this case, it would not be possible to post comments (in accordance with YouTube's rules). We also invite viewers to send Pleiadi videos of their experiments and to reinvent them (e.g., to test types of planes different from the ones shown in the video tutorial). This way, we want to stimulate their passion towards the covered topics and, thus, have them continue the educational activity even after our video has come to an end.

9.2 - What are the videos about?

The purpose of video tutorials is to provide scientific education, rather than simply communicating scientific facts and curiosities. Therefore, their topics were chosen among those typically covered in primary and middle schools - according to our target's age (8 to 12 years old) – to address a wide variety of scientific fields.
The hands-on activities serve both as powerful teaching tools and a way to make education more attractive. For each video tutorial, several alternative experiments were tested to select the ones matching the following parameters: easy to reproduce at home, safe, funny and interesting, useful to explain basic scientific phenomena. This part of the project took a significant amount of time, even more so considering that some experiments require several days to perform.

- Microfungi, bacteria and viruses, and personal hygiene (BIOLOGY/HYGIENE)

The video starts explaining the characteristics of those microscopic organisms collectively defined as "germs" (microfungi, bacteria and viruses), including possible practical uses (e.g., production of antibiotic penicillin) and health risks. Special emphasis is given to the description of viruses and how, by using cells for reproduction, they may cause dangerous diseases.
The main experiment requires viewers to touch 5 pieces of bread with: dirty hands, hands washed with soap (for 5 and 40 seconds, the last one according to the suggestions of the Ministry of Health), hands treated with sanitizer, a smartphone (an example of everyday object). Then, the viewers must check which slice will develop mold faster and, therefore, was dirtier. This experiment shows how widespread germs are and the importance of good hygiene practices to protect not only our health, but also of those around us. The viewers are then invited to follow some basic rules, including frequently washing hands with soap. To show the effectiveness of this common, but extremely useful, detergent, the explainer shows how it can emulsify lipid substances and, therefore, break germs'external membranes, by mixing water, oil, and soap.
Since health is an especially delicate matter, it was vital to communicate information in a very clear way, to avoid possible misinterpretation. This is even more important now due to the recent COVID-19 outbreak and, in fact, part of the video is dedicated to the description of the new coronavirus SARS-CoV-2.

- Chemical solutions and karstification (CHEMISTRY/GEOLOGY)

The explainer shows the characteristics of chemical solutions (at the base of karstification) by mixing lemonade and sugar, a very simple and familiar example of solution. Then, he/she asks viewers to pour a drop onto a flat surface to see how, through water evaporation, part of the sugar reappears in the form of precipitate. This way, it is possible to introduce several basic concepts such as solvent, solute, precipitation, and solubility.
The main experiment consists of producing an artificial stalactite using salt and water. Then, the video shows how such structure, along with caves, stalagmites, and columns are naturally produced through karstification. In addition to describing the natural phenomenon, the video takes the opportunity to explain the ecological value of karst environments and the importance to protect them. This way, viewers may learn not only how karstification works, but also how it affects life forms.

- The origins and effects of earthquakes (GEOLOGY/PHYSICS)

The video introduces the different types of seismic waves (which causes earthquakes), whose ways of propagation are shown by swinging a spring. Then, it describes how tectonic movements lead to the formation of faults and, consequently, originate powerful earthquakes. To explain the basic principles of plate tectonics, the explainer describes our planet's inner structure comparing it to that of a peach (e.g. the core is equivalent to the seed).
The main experiment involves the use of jelly and a toy skyscraper (made of toothpicks and candies) to simulate the effects of seismic waves on buildings. The video explains how several parameters may affect them, introducing many basic concepts (measurement scales, hypocenter, epicenter).
Eventually, the viewers are invited to try again the experiment, first replacing jelly with a puffed rice cake, and then adding reinforcements to the skyscraper. This way, they are shown how building on hard soil (represented by rice) and the use of anti-seismic principles may significantly reduce detrimental effects caused by earthquakes.
This is a very actual topic and even younger viewers may have personally experienced the recent earthquakes that hit Emilia (2012) and, especially, central Italy (2016-17). Therefore, it is even more important to provide them with correct information, so that they may face fear with knowledge.

- Air pressure and the principles of aerodynamics (PHYSICS/FLIGHT)

The video explains the principles of aerodynamics, starting from the description of air and how it may exert pressure on surfaces. This way, it is possible to introduce the Bernoulli's theorem and the principle of action and reaction, which allow planes to fly by generating lift. Some simple experiments are performed to make both concepts easier to understand.
The main experiment consists of a competition between two different paper planes, whose flight performances are going to be compared. This way, viewers are shown how differences in wings' size and shape may affect lift generation and drag, resulting in higher speed or longer flight distance. Eventually, the video explains how pilots exploit drag to perform in-flight maneuvers.
This topic is particularly appreciated by young people and is discussed by many school textbooks. However, we noticed that several sources provide a simple, but inaccurate, explanation of how planes fly. Therefore, the goal of the video is to correctly describe this phenomenon keeping an easy to understand language.

9.3 - The running time

There is no such thing as a "universally correct" runtime for YouTube videos, instead it depends on several factors, including covered topics and public's preferences. Based on YouTube's duration categories, the analyzed videos may be divided into three groups: short (<4 minutes), medium (4<x<20 minutes) and long (>20 minutes).

So, 6 videos are within the first group, 18 feature a medium duration, and only 2 are over 20 minutes long. Therefore, it is likely that viewers generally prefer short or medium videos.

After some considerations, a duration between 5 and 10 minutes long was opted for the video tutorials. This way, there is enough time to delve into theoretical concepts and show practical demonstrations. On the other hand, the videos are not so long that the viewers may lose interest. This is particularly important considering our target's age and its commonly short attention span.

Moreover, medium videos may perform better than shorter ones based on how the YouTube algorithm works. In fact, YouTube promotes videos with higher average view duration (how much time viewers usually spend watching your contents), because they keep people on the platform for longer. Therefore, even if viewers typically watch only half of a 10 minutes video (= 5 minutes), the latter will get more visibility than a 3 minutes video watched entirely.

The video tutorials'duration was calculated based on a speech rate of about 170 words/minute. In case of public speaking, a slower speech rate (from 100 to 150 words) is usually preferred to improve comprehension. However, not only viewers may stop and replay the video, if needed, but studies also show that faster rates increase interest and persuasiveness [B7].

9.4 - Publishing times

Although publishing content frequently may promote the channel's growth (increasing the visibility of videos), the most important thing on YouTube is to publish regularly, at a specific day and time. This way, viewers know when a new video is going to be uploaded and will routinely visit the channel.

In our case, we decided to publish one video tutorial per week. This publication frequency was considered optimal because it helps keep Pleiadi's channel active and, at the same time, allows us to produce high quality educational videos.

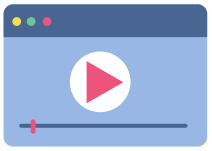
As for days and times, Thursday and Friday (between 12 am and 4 pm) are usually considered the best to publish throughout the week. Saturday and Sunday are good days too, but it is better to publish in the morning (between 9 am and 11 am) [S20].

Among the analyzed channels, the most popular day was Monday (6), followed by Thursday (5) and Tuesday (4), while the most active times were 2 pm, 7 am and 9 pm (all with 3 preferences). In particular, Thursday was the preferred day by channels for children (at least, those whose data were available: Science Max and SciShow

Kids), while the most active times were at 7 am and 5 pm.
Eventually, the choice fell on Thursday at 2 pm, which is also the day when the number of active viewers on YouTube generally starts to increase, before decreasing on Sunday. At 2 pm, young viewers have just finished lunch and are more likely to be at home. Moreover, since the video tutorials are going to be published in June, we may expect kids not to go out due to hot temperatures.

9.5 - Titles and keywords

Titles are very important factors which may affect the success of a video. First, a good title lets users know what the covered topics are and, if they are interested, prompts them to watch the video. On the other hand, they are also important for YouTube SEO. In fact, YouTube analyzes titles (along with the description, tags, and the YouTuber's speech) looking for keywords, specific terms which define what the video is about. Then, YouTube offers the video to the users who may be interested (both in search results and the Up Next section).
Therefore, titles must be attractive, easy to read (within 60 characters), and clear to make sure that the video reaches the right users.
To create the video tutorials' titles, we analyzed the YouTube search results associated with several keywords, each one related to the covered topics. This way, we could check if they actually lead to contents similar to the ones of the video tutorials.
If we take for example the video about aerodynamics, the term "aerei di carta" may seem appropriate (considering the featured experiment), however it is mainly associated with tutorials explaining how to make paper planes. Therefore, we expect that people looking for this keyword are not interested in science education contents.
The analysis also gave us information about the keywords' popularity: less searched terms tend to be associated with less viewed videos.
For example, the term "carsismo" correctly defines the topics covered by the video about karstification, however it seems to be quite unpopular. Therefore, we decided to include also a more searched, and still appropriate, keyword such as "soluzioni".
On the other hand, "lavarsi le mani" appears to be a valid choice for the video about germs. Not only it is associated with similar contents (personal hygiene, microorganisms), but also with several videos related to the recent COVID 19 outbreak. Of course, this is a very popular topic at the moment and, therefore, such a keyword may significantly increase the visibility of the video tutorial.
More precise data about popularity were provided by Google Trends; this tool was especially useful to compare apparently equivalent terms (e.g., "terremoto" is more searched than "terremoti").
The general structure of the video tutorials' titles is set out below:



TITLE SECTION [ESPERIMENTI] Play&Do #NUMBER

- TITLE SECTION:

(1) Perché dobbiamo lavarci le mani?
(2) Il carsismo e le soluzioni
(3) Perché gli aerei volano?
(4) Come nasce un terremoto?

- [ESPERIMENTI]: it is keyword shared by all videos which highlights the presence of hands-on activities. Not only these are generally much appreciated by viewers, but many science videos do not feature them, therefore it could make the video tutorials stand out from competitors (the word is capitalized to catch the viewers'attention). Moreover, the videos may be reached also by people interested in experiments but not specifically looking for the covered topics
- Play&Do #NUMBER: they are, respectively, the name of the video series to which the tutorials belong and the episode's number. This way, viewers are told that there are more, similar videos to watch. Videos belonging to the same series may be organized in playlists; doing so offers two advantages: playlists help viewers find the videos within the channel and make that, once they finish watching an episode, the next one will automatically start. Moreover, links to playlists could be shown during the video, in the form of YouTube cards.

9.6 - Thumbnails

Along with titles, thumbnails represent one of the main factors which may persuade viewers to watch a video. Therefore, even if it is possible to use auto-generated thumbnails, it is always better to create personalized ones to help the video stands out from competitors. Moreover, when producing thumbnails, it is important to create a consistent identity by means of recurrent colors and graphics, to help viewers identify videos from the same series and/or channel.

As regards the video tutorials about karstification, earthquakes and germs, most of their competitors use auto-generated thumbnails, drawings, photos (e.g., of caves and stalactites), and many of them do not include a picture of the YouTuber.

Therefore, we could create thumbnails depicting the explainer showing the results of the experiments (e.g., a fully formed stalactite). This way, we would highlight the experimental nature of the video tutorial. Moreover, thumbnails depicting YouTubers appear to be more attractive and appreciated by viewers, because of their "human touch".

Things are different when we consider the video tutorial about aerodynamics: in that case, many competitor videos are produced by a specific channel (Oneira). Their thumbnails usually depict the YouTuber in front of a photo (related to the covered topics), using text to highlight the subject of the video.

To stand out from Oneira's thumbnails we could use a brightly colored background, in contrast with its less colorful photos. Moreover, Oneira's YouTuber usually keep a quite static posture (with his arms crossed), so we could depict the explainer in a more dynamic pose.

Eventually, we could use text to add information which are not included in the titles:

1- SAPONE VS GERMI; to highlight the content of the experiment and to catch the attention of the viewers (by using the term "germi")

2- "FACCIAMO UNA STALATTITE"; to highlight the content of the experiment

3- “GARA DI AEREI DI CARTA”; to highlight the use of paper planes, possibly making the video tutorial more attractive
4- “SCIENZA IN CUCINA”; since culinary experiments appear to be appreciated by many viewers

9.7 - Description

The video tutorials’description includes several information:

- SUMMARY: a brief description of the covered topics and the materials needed to perform the experiment. Only the first three sentences of the description are immediately displayed below the video player, while the rest is collapsed. Therefore, the first two lines are devoted to the summary while the last one includes a call to action inviting viewers to read the remaining text.
  The most important information (the covered topics) were placed at the very beginning because only little more than the first sentence is displayed in the search results.
- CALLS TO ACTION: like, comment, subscribe, send pictures and videos of your experiments
- UPLOAD SCHEDULE: uploading times
- SOCIAL MEDIA and E-MAIL: links to Pleiadi’s social accounts (Facebook, Instagram) and e-mail address
- FURTHER INFORMATION: instructions to realize materials needed for the experiments or external sources to delve into the covered topics
- CATEGORIES: we chose ISTRUZIONE, another possibility could be SCIENZE E TECNOLOGIE but it does not specifically refer to educational contents

9.8 - Tags

Despite they are not directly visible to viewers, tags are very important keywords which help YouTube algorithm understand the topic of the video.
The video tutorials’tags are divided into two groups:

- GENERAL TAGS: they are shared by all videos and include keywords about Pleiadi (e.g. gruppo Pleiadi), education and experiments (e.g., istruzione; esperimento scientifico), our target (e.g., scuola media).
- SPECIFIC TAGS: they are specific for each video and define the covered topics (e.g., stalattite)

Some tags were copied from videos dealing with similar subjects, by means of the YouTube management tool TubeBuddy.

CHAPTER 10
TIKTOK VIDEOS

10.1 - Videos' structure and runtime

As opposed to the video tutorials, the main purpose of the TikTok videos is not to educate viewers, but rather to catch their attention and redirect them to the Pleiadi's YouTube channel. Therefore, they should be very attractive while giving a general idea of the covered topics.
As a consequence, we resolved to have the videos show the experiments. Not only this kind of contents is very popular on TikTok, but it highlights the practical nature of Pleiadi's educational activities. The first part of the video could be dedicated to showing the materials needed and, through a time-lapse view, the realization of the experiment; the second part would display the results.
Although TikTok allows to upload videos up to 60 seconds long, we decided to stick with the shorter format of about 15 seconds. The latter appears to be the best suited to create eye-catching contents, in particular for younger people. It is no coincidence that 8 out of 10 top 100 videos are less than 20 seconds long [S7]. Moreover, similar results are shown by the analysis of science TikTok videos, which feature an average length of about 24 seconds, with only 9 out of 26 videos over 20 seconds long.

10.2 - Publishing times

Every TikToker has a different approach to the platform: some publish just a few posts a week, while others may even upload 10 videos a day. Among the analyzed science TikTokers, 10 out of 26 display (or displayed, since some of them went inactive) a publishing frequency of at least one video per day.
Posting frequently may greatly promote growth on TikTok, however it depends on several factors (such as the kind of contents, the audience...) and should not be done at the expense of quality.

Therefore, we opted for publishing twice a week, in accordance with a regular release schedule. This way, it is possible to produce high quality contents and, at the same time, keep the account active and healthy.
We decided to publish on Thursday at 12 am and Sunday at 4 pm (which are considered among the best times to post [S13]) to assure a weekly coverage. Moreover, the videos uploaded on Thursday morning may be used to promote the visibility of the related video tutorials (which are going to be published a few hours later, on YouTube).
Anyway, the release of the TikTok videos is still under assessment. Basing on the data acquired from the analysis of science TikTokers'profiles, Pleiadi is currently evaluating the most effective strategies to make the videos as catchy and interesting as possible for young people.

10.3 - Description

TikTok's descriptions usually consist of two sections represented by (1) REGULAR TEXT and (2) HASHTAGS:

- (1): Creators may use this section for many different purposes, such as to express their feelings and opinions about the video's topics. In our case, we could add some information about the practical demonstrations. If we take for example the experiment with paper planes, we may write "Vediamo quale vola più lontano!" to make people better understand what the activity is about.
  Some profiles, such as IOHA, also include calls to action inviting viewers to visit the related YouTube channel. We could do the same or we may add similar information in the form of on-screen text or even stickers, to make it more visible. On Thursday, we could also notify the upcoming release of a new video tutorial on YouTube.
- (2): Hashtags are useful to categorize the video and to make it reach the right viewers. Therefore, it is important to include words consistent with the covered topics. Moreover, creators should not use too many hashtags (no more than 5), otherwise the TikTok algorithm will not properly understand what the post is about [S10].
  We identified several, appropriate hashtags both from the analyzed science TikTok videos and a list provided by Top Hashtags. Moreover, we searched for popular hashtags by means of the DISCOVER section, on the TikTok platform.
  It is important to always check what kind of videos usually include a specific hashtag, because some science-related words (e.g., "aerodinamica") may be associated with non-scientific contents. If we consider for example the paper plane experiment, we may include #scienceisfun; #esperimentoscientifico; #PleiadiScienceFarmer; #aereodicarta; #paperplanechallenge. The first three are general keywords which may be used for the other posts too, while the last two are specifically related to the experiment.
  In particular, the last hashtag is associated with a so-called "TikTok challenge" and, therefore, may significantly increase our video's visibility.

CHAPTER 11 CONCLUSIONS

11.1 - The future of the project

With the end of the design stage and the publication of the videos, a monitoring phase will start.

Both YouTube and TikTok provide creators with useful analytics tools to check the performance of the channel/profile and the videos. It is possible not only to analyze the number of views, but also most active times and days, demographics, and so on.

The data obtained from the project will provide Pleiadi with important information for future plans involving YouTube and TikTok.

Success on social media is, in fact, a matter of trial and error, with many different factors possibly affecting the results. Therefore, testing is vital to understand the preferences of your audience and, consequently, to improve your strategy.

In addition to monitoring performance, much care should be devoted to managing relationships with the viewers. This is true not only for TikTok but also for YouTube which, overtime, has acquired ever more social features. Therefore, it is important to engage with viewers by answering their comments and inviting them to participate in activities, such as performing experiments at home.

It is also important to interact with the other side of the community, in other words, creators. By making collaborations with YouTubers and TikTokers dealing with similar subjects, Pleiadi could reach an even larger audience, significantly improving the channel/profile's growth.

As regards YouTube, it should also be considered the possibility to add multi-language subtitles to the videos. In fact, science communication and education contents appear to be very popular on English-speaking communities. This statement may be supported by our analysis of science YouTube channels, where many creators come from the United States. Therefore, this would represent an important step to provide science educational contents to a global audience, in accordance with Pleiadi's international vocation.

11.2 - Personal achievements

The project WHEN SCIENCE GOES VISUAL represented a valuable opportunity to acquire practical experience in the field of science communication, with particular regard to the education of young people. Firstly, I could test myself with different platforms, from publishing (thanks to the participation in the realization of "Guida galattica al Coronavirus") to videos and social media.

In particular, I could study and learn the operation of two of the most popular social platforms, YouTube and TikTok. This represents an extremely useful wealth of knowledge for modern science communicators, who need it to interact with the new generations of audiences.

This experience helped me develop transversal knowledge of science communication, starting from the identification of appropriate topics for the videos. In this regard, the opportunity to work closely with PopBrains, a society specialized in medical writing, allowed me to learn how to properly deal with delicate and topical issues such as health, avoiding unintentional disinformation.

During the designing phase, I could benefit from the rich experience of Pleiadi in the edutainment field. This way, I learnt how to combine theory and practical activities to help even the youngest viewers to understand relatively complex concepts from basic principles. Moreover, Erika and Daniela showed me how to promote interest and critical thinking by prompting viewers to reflect on topics, rather than simply acquiring information.

Eventually, I acquired skills in video making, from recording to post-production phases. In fact, I personally wrote the scripts and assisted in both video direction and editing. These experiences also allowed me to grow teamwork skills, since I had to work together with the explainers and the video editor, moreover I had to coordinate with Pleiadi's headquarter.

11.3 - Difficulties faced throughout the project

One of the difficulties is undoubtedly the need to communicate a variety of topics in a very accurate but easy way, especially with delicate issues where it is vital not to be misunderstood. This task is even more difficult considering that the project's target consists of young people, who are easily distracted and need to be constantly stimulated.

Another difficulty is represented by the design and performing of hands-on activities.

As for the first phase, it was necessary to perform several tests to find experiments suitable for the project: easy to reproduce, entertaining, and useful to explain scientific concepts. For example, I originally intended to include an experiment on liquefaction in the video about earthquakes. However, I eventually discarded this idea for two reasons: first, it was not so easy to reproduce because it requires sand (not exactly an everyday object); second, it was not suited to explain how earthquakes

work, but rather a very specific phenomenon related to them.
As regards the second phase, it should not be ignored the unpredictable nature of experiments: in fact, even if they worked during pre-production tests, they might not work as anticipated/as they previously did when performed on the set. Moreover, several factors may differ from the place where tests were taken and the set, significantly affecting the results of hands-on activities. For example, we had some difficulties performing the experiment involving jelly and a toy building made of candy. While it worked perfectly at home, the heat coming from stage lights and the long filming times caused such materials to degrade rapidly, complicating things.
In the end, hands-on activities are undoubtedly a very powerful tool to communicate science in an effective and appealing way, but it should be taken into consideration that they may require much time to be designed. When working with perishable materials (such as jelly and candy), I also suggest bringing extra supplies in case of need.

REFERENCES

Bibliography

B1) Cilliers, Elizelle Juaneé. "The challenge of teaching generation Z." PEOPLE: International Journal of Social Sciences 3.1 (2017).
B2) Morcillo, Jesús Muñoz, Klemens Czurda, and Caroline Y. Trotha. "Typologies of the popular science web video." arXiv preprint arXiv:1506.06149 (2015).
B3) Prithishkumar, Ivan J., and S. A. Michael. "Understanding your student: using the VARK model." Journal of postgraduate medicine 60.2 (2014): 183.
B4) Seemiller, Corey, and Meghan Grace. "Generation Z: Educating and engaging the next generation of students." About Campus 22.3 (2017): 21-26.
B5) Shams, Ladan, and Aaron R. Seitz. "Benefits of multisensory learning." Trends in cognitive sciences 12.11 (2008): 411-417.
B6) Trna, Josef. New Roles of Simple Experiments in Science Education. Paido, 2014.
B7) Welbourne, Dustin J., and Will J. Grant. "Science communication on YouTube: Factors that affect channel and video popularity." Public Understanding of Science 25.6 (2016): 706-718.
B8) Zhu, Chengyan, et al. "How health communication via Tik Tok makes a difference: a content analysis of Tik Tok accounts run by Chinese Provincial Health Committees." International journal of environmental research and public health 17.1 (2020): 192.

Sitography

S1) BBC: "Facebook's popularity dips with UK children, says Ofcom" (2019).
S2) BusinessofApps: "TikTok Revenue and Usage Statistics (2020)" (2020).
S3) BusinessofApps: "YouTube Revenue and Usage Statistics (2020)" (2020).
S4) Cè di peggio: "20 canali scientifici da seguire su YouTube Italia" (2019).
S5) Chemical & Engineering News: "Chemists are finding their place on TikTok" (2020).
S6) Children's Museum Verona (Guida Galattica al Coronavirus): https://www.cmverona.it/guida-galattica-coronavirus/
S7) Dan Slee: "CLIPPED: I watched the 100 best TikTok videos to find the optimum length of a clip" (2020).
S8) DataMediaHub: "Audience & Tempo Speso di TikTok in Italia" (2020).
S9) Filmora (YouTube marketing): https://www.filmora.io
S10) Fixing Port: "How To Use Hashtags On TikTok? [An Effective Way]".

S11) Flux Trends: “Meet Generation Alpha” (2019).
S12) il Post: “Anche i medici provano a stare su TikTok” (2020).
S13) Influencer Marketing Hub: “Tips for Best Times to Post on TikTok (+How to get More Followers Faster)” (2020).
S14) MakeUseOf: “The 10 Best YouTube Channels for Wacky Science Experiments” (2018).
S15) Massive Science: “TikToks are teaching Generation Z about science” (2019).
S16) Medici oggi: “Guida Galattica al Coronavirus – un albo illustrato multilingue dedicato ai più giovani” (2020).
S17) Mimio Educator: “Why Hands-On Experiments Are Important” (2017).
S18) NDT Resource Center: “Encouraging Students to Experiment & Explore”.
S19) New York Times: “Doctors on TikTok Try to Go Viral” (2020).
S20) Oberlo: “A che ora pubblicare su Instagram e sugli altri social media” (2019).
S21) Ofcom: “Life on the small screen: What children are watching and why” (2019).
S22) paul injeti seo: “TIKTOK SEARCH ENGINE OPTIMIZATION GUIDE” (2020).
S23) Pedagogy in Action: “Why Teach with Classroom Experiments?”.
S24) Provincia di Torino: http://www.provincia.torino.gov.it/istruzione/cesedi/sis/linguistica_letteraria/dwd/fallo_intr_37.pdf
S25) Techcrunch: “Instagram drops IGTV button, but only 1% downloaded the app” (2020).
S26) techechonomy: “La (in)sostenibilità della scienza su TikTok” (2020).
S27) TikTok: “The science community shows off on TikTok” (2019).
S28) Top-Hashtags: https://top-hashtags.com/hashtag/science/#:~:text=Hashtags for %23science in 2020 to be popular and trending,%23sciencenews %23physics %23scientists .
S29) VARK a guide to learning preferences: “The VARK Modalities”.
S30) We are social & Hootsuite: “Digital in 2020 Italia” (2020).
S31) We are social & Hootsuite: “Digital in 2020” (2020).

Tools

Google Trends: https://trends.google.it/trends/?geo=IT
noxinfluencer: https://www.noxinfluencer.com
YouTube Kids: https://www.youtubekids.com

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