Chapter 17
Is Misinformation a Challenge for Science Students in the Digital Era?

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ABSTRACT

This chapter will focus on the perception of scientific topics throughout digital dissemination and educational activities. By assessing the evolution on the impact of massive online information dissemination in scientific topics, the chapter aims to address the issue of quality and reliability of scientific information, disseminated towards university students. For this assessment, it will be argued if we must be concerned about a new generation of students being (intentionally or not) misinformed about core insights of their development. This will be done by outlining the major influences of digital and social media in science students' scholastic activities. By adapting scientific models on the spread of misinformation, this chapter argues how students can be subject to gather and to be exposed to unfiltered data, which can potentially be demeaning to their educational development.

INTRODUCTION

Never has the concept of massive online learning gained as much momentum as today. The widespread pandemic of SARS-CoV-2, coronavirus outbreak in early 2020, pushed several restrictions to student and academic mobility (Allo (2020)[1]). As this chapter is written, all major universities in the European Union are closed until further instructions from public health services[2]. In the case of Southern European Universities and Schools, all institutions were shut down as a state of country-wide quarantine was established. In the following days, the Offices of Public Education and Higher Institutions, sanctioned schools to prompt contingencies as to shift education to an online base[3]. At the time of the proclamation of quarantine, university students stopped their curricular activities, canceling regular events for the

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remaining six months of the academic period[4]. As such, education and other branches of society were encouraged to materialize their activities online. Although, at a University level, many schools have already adopted many resources and activities over the internet, nothing at this scale was properly implemented or even tested. The logistics of this "quarantine plan" are challenging. To assure online classes for all University students, as well as performing evaluation activities, institutions navigate through uncharted waters. However, several questions must be addressed: can internet-based solutions provide the response we need? Or, most importantly, can an online course mark the same performance as a traditional class?

With this renewed interest in digital solutions for educational purposes, the development of Massive Open Online Courses (MOOCs) was deeply explored. Different from a simple online page or resource, these MOOCs can reach and provide free open online courses to virtually every student in the world (Baturai (2015); Lee (2018)[5]). Multiple online platforms provide distinct courses, taught by certified university teachers on subjects such as exact sciences, social sciences and computer science. The blended resources for these classes consist of traditional video lectures, evaluation quizzes and other curricular assignments. Nevertheless, as they are open sourced materials and could be linked to an educational institution, one cannot assure a specific course for a unique curricular unit across the globe. They can provide resourceful insights on capital themes, in a broad spectrum, as individual students evaluate the way they can incorporate this knowledge in their school activities (Daniel (2015);Yuan (2013)[6]). Hence, one must embrace the value of MOOCs as complementary scientific repositories of credible academic information, to an undergraduate course, especially when students gain consciousness of their independence in obtaining scientific information.

Using the internet as an important source of knowledge is not a novel concept to university students. Several authors claim that there is a significant gap in scientific literature on the impact of new digital learning methods on student formation (Brundell (2016); Ertmer (2012)[7]). The influence of online journals, magazines and other vehicles of science dissemination (such as online videos and forums) on creating knowledge that thrives the learning process of university science students worldwide, is seldom addressed. This issue is even more noticeable, as nowadays there is more public awareness of the new digital forms of learning, embedded in scientific and social platforms, such as social media (Napal (2020); Yacob (2012)[8]).

Therefore, is it possible to establish a connection between online courses, social media and university education in this digital age? Some reports have studied the individual engagement of students and their scientific education awareness, which in turn, linked the methods in which social media can enable creative student thinking (Wagner (2012); Corso (2013)[9]). In this sense, one must ask: where will prospective students search for their school everyday queries? In an extensive online course with roughly 50 minutes, a textbook in their campus University Library, or a simple 5-minute video on YouTube? As selected students claim, they are more drawn to the premise of learning selected topics from a simple tutorial online (Henderson (2015)[10]). Thus, our focus must be broader. How does the validation of social media contribute to science education efforts, in an area where there is little evidence of proficient use of social media in academic scientific teaching?

When confronted to the possibility of assisting an MOOC, science students stated that they would rather obtain information on a specific scientific question from a social media source, then from outputs related to MOOCs (Henderson (2015)[11]). The same study also argued that students who regularly attend social media platforms, consider these tools as valuable information providers. Although they show a "filtration process" to choose in which content to trust, the eventually report that when they find these contents appealing, they retain more permanent information, regarding certain subjects.

The quality and source of this information, however, is constantly a concern. In this era of "fake-news" and scientific misinformation thoroughly disseminated in online mediums, can students differentiate "good" from "bad" science? (Rose-Wiles (2018)[12]). Are they seeking plausible information sources? Therefore, the analysis on creation and accumulation of scientific knowledge that sets the tone for the education of a new generation of scientists is the cornerstone of this chapter. In a highly competitive and changing global society, students must grab their roles as scientists of a new globalized information age, as younger generations need to be prepared.

With this outtake, how can we know that the right information is passed on to the students? Is the danger of scientific misinformation only personified by fabricating "fake-evidence" or "fake-knowledge"? Biased scientific production is a recognized successful strategy for misleading the public (Scheufele (2019)[13]). However, that may not be the main obstacle. "Selective sharing" of information, specifically modified to target certain groups of people with common values, while omitting facts that the communicator does not want to be spread, can have more impact than "fabricating a whole scientific evidence" (Correia (2019)[14]). As the validity of scientific information is often questioned, it can also be said that what people believe will depend on what they are familiar with. So, therefore, a question must be asked: are students, as a group, more subject to malign scientific influence, than ever before? What can be done to overtake this issue? It is crucial to know how and why the production and dissemination of scientific information has been influenced by the action of scientists, the public and other third parties.

The presented chapter layout is threefold. It will begin with an assessment on digital and online learning, particularly analyzing the evolution of MOOCs amongst university students. The focus will be on how and why they are used by science university students as a learning tool for their academic development. Secondly, several examples of major channels that students are using, at university level education, are presented to outline their main source of digital information. It will focus on what digital mediums students use to answer course related issues. Finally, the circulation of those information routes will be discussed, particularly the potentials and demeanors of digital based scientific content. This will be done by establishing our arguments from an adaptation of a scientific model, from which we derived our findings.

TOWARDS A DIGITAL EDUCATION

An Overview

To appropriately address the issue of misinformation in an educational online medium, one must understand what is the general perception of online education. Probably as fast as the field evolves, its definition tends to adapt towards its circumstances (Sun (2016)[15]). But if one tends to isolate the explicit characteristic that separates online from traditional learning, the word "presence" comes to mind.

As defined by McIsaac and Gunawardena back in 1996, online learning is nothing more that eliminating the special contingency of the student and teacher in the classroom[16]. Simply put, one transfers the terms and practices from a classroom to a digital environment, extracting the physical presence of a teacher. But this definition opens a possibility for eventual digital loopholes. It does not specify the context of the teacher, or the lesson taught. It is easy to understand that with the current proliferation of digital content vehicles, either text or video, it makes viable to students to be immersed in different educational contexts. Skipping to 2012, Moore and Kearsley present a definition more suited to this approach[17]. It recognizes this to be a learning tool, allowing the participants to communicate in different physical spaces through technological enhancements. However, it frames this tool with a "special institutional organization". On top of this, Finch and Jacobs in the same year amasses this notion with the specificity of "a form of teaching" in which the interlocutors are not in the same geographical site, for a temporary timeframe (Finch (2012)[18]). This is an important notion, as it makes the purpose of online sessions as complementary to traditional classes. And it makes sense, given the structural foundations of traditional university and early educational levels. But even more traditionalist scholars must recognize the paradigm shift in the conceptualization of academic courses. The new methodologies allow many possibilities beyond the lack of physical interaction between teacher and student. In this case, blended learning serves at the utmost example of different possibilities. Recent reports show that the positive outcomes from it uses, from how those activities are interlinked with online features, and how they are perceived as part of a broad teaching process (Sun (2016)[19]).

One can ideally divide the motivations to online education in three basic reasons: equity, opportunity and efficiency (Moore (2010); Finch (2012)[20]). The need for online education comes from a permanent need in a globalized society. One must not forget, though, that these dimensions are complex enough when dealing with current issues on online learning methods and practices. More so, if we consider that education policies (public or private) are supposed to highlight the challenges and innovations in the field. In the current pandemic state of COVID-19, many opportunities are set to enhance and employ key aspects of equity in distance learning, due to quarantine-type measures. Not only to address present issues, but to set standards to enhance the above-mentioned motivations in future similar events.

As the prerogative for current traditional university formation, student mobility is viewed as an asset to a curriculum. Pupils should not be spatially dependent from the site of formation, giving them a degree of freedom of movement. They can use the time between the classes to take part in other activities outside their campus. But the equity argument goes further. As in some European countries, student housing and commuting costs keep increasing. In some cases, student aid is not sufficient (or seldom attributed) which can be a relinquishing factor to enroll at a university. The ability to attend classes and perform other kinds of activities that do not need compulsory physical presence of the student, in these cases, can be decisive in a student enrolment. Virtual infrastructures created with this purpose, present an improvement of quality of existing educational operations, enhancing the raw capacity of its system.

However, this "democratization" of opportunities must be done without schools falling to the temptation of increasing the knowledge gap (Tichenor (1970)[21]). Opportunities to transmit knowledge, either by face-to-face-classes or by online learning methodologies, must be the same and just not to answer a prospect to engage more publics. As presented by Carpentier (2018), one can present a parallel between the dissemination of knowledge and information and the distribution of wealth in industrialized social systems[22]. As the perfusion of media information into a social system increase, people with higher socioeconomic status tend to attain knowledge at a faster rate than people from lower status. The generic idea is that the access to information is gapped between people with different incomes. When this idea was presented, in the 1970s, information is described as a commodity, a consumption good that is accessible to people who can afford it. The same scenario can be applied to higher education, as economic backgrounds can be an issue to enroll in certain universities. But even after enrolling, students need to pay for books, study material and, nowadays, information supplies. As such, higher education is broadly installed as a mean easily accessed if you could afford it (Donohue (1975); Correia (2019)[23]). To tackle this issue, MOOCs can play a huge role in cutting back the size of the knowledge gap. Public education offices can easily engage policy makers to the urgency of making available valuable knowledge for most of their citizens. As the digital world tends to empower people from various socioeconomic backgrounds with the use of technological tools, a massive dissemination of MOOCs can be an answer to address this pressing issue. A practical example is the current pandemic of COVID-19: fully disseminated and corroborated courses available to the public, can easily transmit key messages to understand this ever-changing situation.

MOOCs and The Rise of Online Learning

Teaching itself cannot be simply an end to a purpose of completing a curriculum. It provides means and tools to a student. Tools that cannot be completely in the shape of pass or fail grade. They harness an opportunity to instruct future generations, beyond the traditional member who can afford high education (Sun (2016); Moore (2010)[24]). With this broad access, the cost-effective balance for student and school is remarkable. It can make itself able to more groups of people, enhancing the capacity of the educational system. As such, other traditional conceptions can be addressed. People from other age groups, such as full-time workers, can now be offered the chance to participate in these classes remotely. Therefore, they can adapt their working schedules with ease, overcoming the logistic of attending university (Sun (2016)[25]). This is very relevant for those who not only want to enhance their competencies but also for those who need theoretical updates and renovations for updating their work skills.

Efficiency is another prerogative of online learning. The possibility of educating these groups for key target areas, without all the bureaucratic installment, makes it easier to expand the educational capacity on several subject areas. This is crucial for the integration of supervised learning. In this sense, we can outtake the advantages of online learning. While discussing the best practices of online education, Finch and Jacobs (2012) stated these advantages: reducing the time and costs for travel[26]; increasing opportunities to access and collaborate with expert professionals in a global range; providing students with flexibility to attend courses at their convenience; and allowing adjustments to subjects and content need (Finch (2012)).

The materialization of online education and dissemination activities can be classified in a user based thematic (Sun (2016); McAuley (2010)[27]):

Major Types of Online Education

- **University-Based Online Education:** where users intention is to obtain a University degree.
- **Massively Open Online Courses (MOOC):** whose users are self-proposed individuals and whose programs are based on their learning goals, prior knowledge and skills.

However, we must not forget about the students who already have online courses based on existing Universities. At those institutions two modes of online classes are usually offered – fully online courses, and blended/hybrid courses (a combination of face-to-face/web-based and technology-oriented format). Students in these two modes of online programs are granted degrees and certificates when they complete required courses and internships. In this chapter, we will focus on the major segment overviewed in this book, regarding Massively Open Online Courses.

To increase the accessibility to higher education by larger segments of the public, the model of MOOC was introduced in 2008, which includes university-based and corporate-based online offerings. The university-based offering was initiated by Ivy league higher education institutions. Most of these are open to the public, free of charge, which shows the universities' efforts to encourage the public to participate in online education.

The nature of MOOCs incurred higher enrollment and higher attrition rate than traditional online education, as they expanded at an exponential rate since 2011. However, it is estimated that in general, the completion rate of MOOCs is less than 7% among top MOOCs provided from major universities (Jordan (2014)[28]). Even among learners who intended to complete a course at the beginning, the completion rate is about 22%, which is lower than that of traditional online education (Reich (2014)[29]). The higher attrition rate of MOOCs compared to the traditional online education may occur because the learners are from more diverse background. With more varied education experiences and motivations than those enrolled in degree-granting institutions, learners have the freedom to take and drop courses without costs, but at the same time, the certificate issued by the platforms are not widely recognized (Jiang (2016)[30]). Learners reported that the lack of time, insufficient math background and having no intention to complete, as reasons for their early withdrawal from online courses.

Before analyzing what can drive students to these teaching methods, one must understand how they interact and use them. Some studies have reported on the student engagement within MOOCs. Several scholars have made different categorizations and classifications of MOOC learners' engagement patterns[31].

MOOC Student Types

- **Lurkers:** who enroll in the course just to observe or sample a few learning materials at most. Some of them may not even get beyond the registration, so they are basically behind the scenes.
- **Passive participants:** who typically watch videos, perhaps take exams, but tend not to participate in the course's activities or discussions.
- **Drop-in participants:** who actively participate in specific topics within the course, but do not attempt to finish the course.
- **Active participants:** who fully engage in the course and actively participate in course discussions and social tools, as to complete the course tasks and activities.

From this categorization, one must question if this approach, undeniably useful, can be used as a positive solution for students. One of the most cited benefits of online learning is the reviewing, replaying and revising of digital learning materials (Henderson (2015)[32]). Often these benefits are related specifically to viewing content for students who have missed a certain class. Digital technology, therefore, mitigated unavoidable unattendance, due to illness, or simply because students can attend classes when they "feel like it". However, in a scenery of impossibility of physically attending these classes, this solution comes as a fruitful one. These benefits were also reported by students who had attended the original live classes but wanted to re-access and consolidate and clarify what they were taught.

Digital video and audio recordings are widely embraced by students, for allowing repeated and focused engagement with teaching content. Digital learning content could be broken up into digestible segments, at a pace constructive to their learning, with the ability for re-listening, skipping and getting to relevant points. Tellingly, the possible use of this technology was valued by some students more than any actual engagement. The online distribution of lectures was felt to be reassuring as a backup of the everyday learning activities, as students can access them when they cannot attend in person at the University.

MISINFORMATION OF SCIENCE STUDENTS IN THE DIGITAL AGE

Science Students and Their Digital Habits[33]

The traditional mediums for online education go beyond the simple recording of a teacher presenting a class on a certain topic. It is broader than that. The trigger for this use can be either the need to complete a certain task or answer a simple question the student may have. In this sense, where do we begin to outline sources of information?

Consider a digital device, connected to the internet. What is your first thought, if you need a specific information? To use a search engine, probably. Surveys shows that students tend to use a common search engine, like Google or Bing, prioritizing over a query in a dedicated site (Creighton (2013)[34]). Some mention the "Google Scholar" application of the Google main search engine, but it is not perceptible if the prioritize or use as a default choice.

In that capacity, a similarly referred benefit identified with the utilization of digital innovation is for researching information. This basically included the utilization of online library databases. As commonly stated by university students, some have not even once checked out a physical book at the University. The wide accessibility of literature on the web (and from home) makes it simple to find and perusing the intended knowledge (Henderson (2015)[35]). While a few understudies adopted a moderately rough strategy to their online research (instead of looking through a huge number of books, they simply type into Google), others profited by "keenly separated" data that can give a scholarly edge. These students preferred position was regularly connected with the recovery of "valuable information" to them, with a substantial number of references in the bibliography.

Other obvious benefits are the use of digital technologies for communicating and collaborating with fellow students. This is particularly associated with formal mandated group work, with technologies such as Facebook and Google Docs, reckoned to make working in group a lot easier and useful by co-ordinating a virtual team[36]. These technologies make it possible for group assignments to be a useful learning experience and not just an exercise in group endeavors. These benefits are also cited in terms of connecting and sharing information. Social media provides a medium where students can casually bounce ideas off friends, particularly those interested in similar areas, without feeling outcasted if they submit a so called "dumb-questions" (Henderson (2015); Macaskill (2013)[37]).

Also very commonly cited in the literature, is the role that technology plays in augmenting university learning materials. Popular examples are videos hosted on social media platforms (such as YouTube, allowing students to view content in a dynamic way) and information posts on Twitter and Facebook (that enables them to glean important news). Most often, these sources were described as offering help to students when they experience a "difficulty with a specific topic, struggling to understand something being taught at university" (Henderson (2015)[38]).

Often when studying a new concept introduced in the classroom, some students may struggle to understand it fully, simply using the outputs that are provided by their lecturer. Some of them, with YouTube, can easily search key terms and a whole list of videos will be supplied to them with different examples. It is not farfetched to think that undergraduate university students find textbooks and some handouts as over-complicated, as some do not explain things very straightforwardly. The antagonist for this outtake, is Wikipedia, as it can usually explain concepts clearly to students.

Less frequently mentioned were the learning-related benefits of using technology to look into information in different ways Creighton (2013)[39]). More and more lecturers demonstrate concepts or ideas using digital media. Science students, for example, should value their teachers' use of drawing software to "explain mechanisms and draw them". This is a significant upgrade from saying "this line here, and then that line there", as they can draw and change models to show different examples.

Some students described these uses as leading to "deeper" learning. The use of videos, for example, was described as allowing lecturers to illustrate a topic and get students to connect on a deeper level than just theoretically. However, these forms of digital pedagogy were simply described as amusing, making learning more fun and loosen-up the lecture. Many students appreciate these outputs, as they can find some external stimulus to be part of a theoretical class.

Despite all the different ways digital technologies can change the way students gather their information, technology-supported "learning" appears to be centered on the completion of certain learning tasks in an expedient and/or efficient manner. The digital practices are, in this sense, useful as they can clarify topics and aid students learning goals, providing help to find information.

This then raises the overarching question of what – if anything – needs to be "done". University students are certainly finding and making good uses of digital technologies that "work best" for them within the context of their undergraduate studies. However, these uses and practices are not the most expansive, expressive, empowering, enlightening or correct ways in which digital technologies could be exploited.

Science Students and the Role of Social Media[40]

Richardson (2015), sums this reality with a simple quote: "students are more bound to leave their home without their wallet, then without their mobile phone". Understudies rely on their mobile phones to check where they should go for their next class, what schoolwork to do, what data to consider, etc. They are, likewise, accomplishing their scholastic work on mobile phones and tablets instead of personal computers. Some studies have found that they also use their phones to oversee class work and to interface with their peers and plan meeting times. Students are more prone to send and share their data through social apps, such as Facebook, finding out that they could arrange meets and study groups through it. This kind of app is fruitful when it comes to convey important messages to all course takers, as to everyone is in touch with the latest academic information and activities (Creighton (2013)[41]). As it is commonly pointed out, as students could not have the opportunity to be physically in the same place, they state social media helped them to do distance group coursework. They do not need to meet at a specific time, as they can figure out how to complete the undertaking needed. General assumption is that students are utilizing web-based features to facilitate course-related gathering ventures, without really meeting up personally. Group assignments, that previously could be faced as several individual pieces for each student, can now use digital innovation to turn this task into a single gathering one, where everyone can jump in and edit at the same time.

But this digital era brings more to the table than just reduce social distancing. Students used online informal communication to find answers to express requests, which are suggested to them persistently. One may just type in "Math Problem Solver" on a search engine and sort out some algebraic problem. Some may even find the help they need to pass through a class, without putting as much effort as it would be considering if they solved their problems by heart. If we asked a group of students, regarding whether scholarly accomplishment would be continuously inconvenient without their digital apparatus, they might point out that university and school could become harder and monotonous. It is simply not as dynamic as popping a problem into a device and meditate on the answer. Smartphone or tablet applications, or "applications", outfitted individuals with supportive, viable, and straightforward access to academic information, developing a sentiment of autonomy in the mission for educational accomplishment. Social apps could assistance with accomplishing their schoolwork and right now, to their educational accomplishment. They can easily explore several themes through articles and papers on their digital devices. It is simple as resuming their research into a catchphrase and enter it in a common search engine.

From this perspective, examining the class information digitally prior to the class, can make the course easier. Individuals as such, showed that they use YouTube videos to help them with understanding materials outside of the constraints of a classroom. They can look for another perspective on a subject that they consider hard. A student once reported that all the classes he attended of a certain subject were extremely difficult. However, when seeing a YouTube video for the same topics, he considered that it was altogether more straightforward. He can just pop up the video at any time during the class, and attain a different perspective from his teacher.

Therefore, the problem is this: while teaching is moving towards a dematerialized version of itself, are students' methods also migrating to a digital stance? And more importantly, how are they doing such an exodus? Their primary source of knowledge is from some form of digital handout. Imagine this scenario: in a final exam type course, a student analyzes the syllabus and extracts the main topics. Then, he searches the bibliography to study those topics. However, many of them skip this phase, and/or do not find it easier to find a simple explanation to the subject. Where will they search? Certainly, in the mediums they are accustomed. Search engines in the digital age are the pandora's box to student learning. Then can provide limitless answers to a simple question. And the beauty of it all, is that they are free to expand. However, this comes at the cost of not having validation procedures to the publishers of those contents. One must not expect everyone that posts a video about chemistry to be a licensed teacher on the subject. To find and share a source of information, is a fundamental vector in studying educational habits of university students. As we have seen, it is very easy to find an answer for a specific question digitally. It may be not the most correct or fundament answer, but Google or YouTube can certainly provide one. Many of the syllabus programs do not contemplate a curricular course on how to evaluate good form bad sources. Of course, it is not as simple as the wrong click on the wrong website. Unlike videos from MOOCs where the source of the information provided is reliable and can be traced back to an establish University, YouTube videos on the same subject are not subject to a same assessment. And, ultimately, the social media videos are easier to find, and often convey dynamic and simple explanations to students, eager to understand a certain subject. This may be out from of spite, or simply because, they are not trained, informed or interested in the traditional channels. Simply put, it is easier this way than asking a teacher or browse thought a library.

But what does this have to do with digital education? Well, from the moment students are digital natives, they do not suspend being social media users. They share. And they share based on their likeness of the video, post or article. The issue is not how they choose the information they want, but how they obtain it. Instead of going directly in libraries or book search engines, innocently they choose mainstream search engines and social media. The main factor is the easiness they can obtain information about anything. And from the point they get the answer they need, there is not a toll that separates the certified science information providers from others. We are not saying that all the others are wrong. But they lack the deepen analysis required to assure a university student. And, as such, they can pass a message that might be true in a broad version, but do not assure the necessary technicalities students need to have in their formation. And of course, there is material and sources that are wrong. Either intentionally or unintentionally, they pose a threat to students and education providers. We must not negligence the power of misinformation spreading. In general, one may trust our students to be critical about the information they have. But can we really be that supportive of them when it comes to choose an answer?

When talking about information on social media, it is necessary to address a key aspect to tackle misinformation. Audio-visual literacy is understood as knowledge on dynamic images is paramount for everyone (Carpentier (2018)[42]). The driving aspect is the teaching of separation of education and entertainment – not to be confused with edutainment. One such example, are YouTube videos we mentioned as sources of studying information. However, this as to be recognized an ongoing innovation. Videos have an outstanding strength to communicate science, as part of the current effort against misinformation and bad science dissemination. There are some digital repositories, built by teachers and educators, as to condense essential information in one dissemination platform. Notably, the works of Nico Carpentier (2018) on the intersection between science and art, he highlights the possibilities of articulating image and the written word. He suggests appropriating audio-visual techniques commonly used in entertainment and employ them to train young science students. He argues that by presenting a topic on a video, can be much more significant than writing an essay expecting to be read. The exhibition of concepts allows him to communicate with an "outside world" and reach audiences that, with academic text he would never reach. On that note, some scientists believe that one way to tackle misinformation can be achieved by occupying media space as counterpoint to non-certified information, as to stimulate young people to study and communicate science. Science and audiovisual methods can also go together as symbolic systems, as their common goal should be the construction of understanding worlds through humanly understandable interpretations (Moreira (2019)[43]).

Can Science Students be Digitally Misinformed?

The Trouble With (Mis)Information

Students can attain specific university-grade knowledge from a digital window. It is as simple as that. In a digital society, the questions we all intend to ask, need to be answered right away. There is so much information we can grasp at the touch of our fingertips on our mobile phones than we can ever imagine. Can we take this as a positive thing for students to gain gradually more access to knowledge? We have seen through this chapter that students can use digital media to do two things: to learn and to share. They are eager to learn what they need to accomplish in their coursework, and they are eager to learn from their peers. In the same sense that knowledge they learn more is to be shared and propelled throughout their social network. Not only by sharing their knowledge daily, like several conversations, but also when they do coursework together. The digital advances that enable students to do this more can also be as a tool to misinform them.

What does misinformation have to do with all this? It is easy: who controls this information? Unlike MOOCs, there is not a supervising entity that oversees these videos or information. Despite these reasons, the dominant concern in this issue comes with one word: sharing. The action that takes us to misinformation. While there are malicious misinformation-spreaders on social media, misinformation would not have gone so viral without regular social media users. Many users propel the spread of misinformation when they forward to their own social networks (Wardle (2017)[44]). Some of misinformation sharing could be prevented as misinformation is inaccurate information that has already been refuted (O'Connor (2019)[45]). For students, misinformation can come from several sources: a YouTube video where some scientific point is not explained; a journal article that has been disproven or with experiments impossible to replicate; a simple blog post from a colleague they deem trustworthy, but is wrong on a certain topic.

Several factors contribute to the widespread of misinformation on the internet. Someone with malicious intent can fabricate misleading content. In addition, social bots can aggravate the spread of such misinformation. On the receiving end, cognitive biases, including confirmation bias, that humans exhibit and the "echo chamber effect" on social media platforms make individuals more susceptible to misinformation (O'Connor (2019)[46]). Social media platforms have become a place for many to consume news and, in some extent, science information. However, despite being social media savvy, younger adults are vulnerable for determining the quality of information online. The ability of younger generations, ranging from middle school to college students that grew up with the internet and social media, in judging the credibility of information online is, at this point, bleak.

SOLUTIONS AND RECOMMENDATIONS

A Model for Digital Influence

Why does this happen? We can think about a group of students gathering and sharing answers to a course query. As they continue to gather information, they start to influence their colleagues. Some of these come to the belief that the information shared is the right one and they will start to gather evidence about it themselves. A single student can persuade new students and their peers. The answers spread throughout their social network until everyone agrees. This means that a successful new answer can spread in a way that would not have been likely without the ability to share it. Without sharing, the chance that each independent student decides to check this alternative possibility is minuscule.

In this segment, we explore the implications and possibilities of the spread of misinformation in science, particularly, students. The base of this analysis is inspired in the works of Cailin O'Connor and James Weatherall (2019)[47]. They used tools of the philosophy of science to design models (or epistemic models) to predict the outcome of the spread of misinformation among scientists. The resemblance of information sharing, as both vehicles and sources are similar, we explain the adaptation of some of these models to a science university student universe.

Step 1: The Spread and "Zollman Effect"

The spread of information and answers is a double-edged sword. It gives exceptional abilities to create refined information about a subject, yet it likewise makes the way for the spread of misinformation. We see this in models when researchers handle troublesome issues they would all be able to come to concede to an inappropriate thing. This happens when researchers get the string of misdirecting results and offer them with their new partners. When students could assemble data from an uncertified source, sharing evidence enables the entire group to get to the correct data, convincing the individuals. This procedure could prompt an agreement around the deception. The sharing of evidence can persuade many with right convictions that an inappropriate assessment was valid.

This exchange, where associations proliferate genuine convictions, opens channels for the spread of misinformation. It is better for a gathering of researchers to convey less information, when they deal with a tough issue. This action, where researchers improve their convictions by neglecting to impart, is known as the "Zollman effect"[48]. If everyone shares data, a possibility string of awful substance can convince the whole gathering to desert the right answer. However, in a group where not every person tunes in to everybody, pockets of students can be shielded from misinformation and keep on the correct conviction, that in the long run concedes the right conviction or answer (Zollman (2007)).

Another approach to put this, is that variety of information is essential for the studies. On the off chance that everybody begins looking through a similar data in related social channels, they can neglect to evaluate better choices. It is significant for any event to test various prospects, with the goal that the group will, in the long run, locate the best answer. One approach to keep up this assorted variety is to "confine correspondence", with the goal that students do not affect each other, while they test different options. It works in view of evidence sharing. If a solid proof for an amazing new hypothesis shows up right now, the associations between researchers will permit the fight to, in the long run, grab hold and spread.

Step 2: The Search Engine Gate

The models of scientific networks we have described, suggest that scientific communities (or in these communities of students) should turn strongly towards consensus, as they gathered and share evidence. Eventually, influence and data flowing between students should imply the entire group. In the models we have consulted, they assume that all scientists (or students) treat all evidence the same way, irrespective of all sources. Is this reasonable to all scientists (or students) trust one another? They can consider all of them well reliable. But when the toll gate for articles and scientific content is provided, by a common or social search engine? Students are not looking in the primary source of the information but are asking an algorithm to choose for them. Are we really to expect students to separate good from obscene suggestions?

Introducing an analogous minor change to the proposed models, they radically alter the outcomes. Instead of steadily trending towards a consensus either right or wrong, students regularly split into groups holding two beliefs with each side trusting the evidence of only does agree with them. Initially, students' beliefs are randomly distributed. Most of them begin by listening to an updating to the basis of the evidence produced by other scientists. But over time, groups of scientists begin to pull apart until eventually you have groups with a poor opposite beliefs or to not listen to each other at all.

There are scientific models where scientists are mixed with other sources of information and guidelines, such as policy makers, to mesmerize a real landscape. We can adapt this model, by saying students are scientists, that can refer to their information from a digital provider, serving in a way like a policy maker. Like scientists, the public and students have beliefs, and they can update them in a line of new evidence. But unlike scientists, they do not produce evidence themselves and so must depend on their network to learn about these subjects. Some students might listen to just one good source, others to all of them or to some number in between.

Frequently, as the network of researchers arrives at agreement on the right activity, the understudies approach assurance that another activity is better. Their confidence goes in absolutely a misguided course. More worrying, this conduct is frequently steady, as in regardless of how much proof established researchers produces, as long as the computerized source stays dynamic, the understudies will never be persuaded of reality. Notice that right now, digital sources do not manufacture any information. They are passing on genuine science, in any event as in they really refer to writing. They simply distribute the papers and articles specifically.

Step 3: Selective Sharing

Regardless of whether it is not a unequivocal misrepresentation, this kind of specific distribution surely appears to be fishy. However, it is critical to underline that specific production is regular in science, even without modern impedance. Analysis that do not yield energizing outcomes frequently go unpublished, or are consigned to minor journals where they are seldom perused. Results that are equivocal or indistinct get left out of valued journals. The consequence is that what gets published is never an ideal impression of the studies that were made (this training is at times alluded to as "selective sharing" as seen in Weatherall (2018) and Correia (2019)[49]). This perception is not intended to excuse faulty articles, carefully selecting those with a one-sided creation methodology. One approach to consider what is going on in these models, is that there is a back-and-forth trade off among students and the used search engine, when something is searched and eventually researched. After some time, the researchers' proof will in general prescribe the genuine conviction: more examinations will bolster the correct answer since it yields better outcomes and by larger numbers.

The last step we discuss is "selective sharing." Selective sharing includes looking for information that is led by researchers, with no immediate intercession by the digital sharer who distributes search results (Bigman (2019)[50]). In a similar model, a search engine can actualize selective sharing via looking through the outcomes delivered by mainstream researchers and use other criteria to show the selected results. From multiple points of view, this winds up looking like a one-sided creation, in the sense that the search engine is sharing just selective outcomes. But a Google search does not produce evidence or knowledge. They simply exploit the way that the information is delivered by researchers to students and the public. And, in the end, there will, for the most part, be a few outcomes recommending that an inappropriate answer is better. Consequently, the viability of selective sharing relies upon the subtleties of the issue being referred to. If researchers are gathering information on something where the proof is not consensual, there will in general be more results proposing that an inappropriate activity is better. In addition, as the rise of irregular or shady evidence and knowledge is accessible, the more material the search engine must distribute.

This perception prompts an astounding exercise for how we should store and report science, as O'Connor and Weatherall report. You may think it is commonly better to have more researchers deal with an issue, as this will create more thoughts and more entropy on the subject. That is why massive outputs of information, mixed with an increasing number of student searches, can be subjected to exposure to ill-founded structural evidence.

FUTURE RESEARCH DIRECTIONS

However, this outtake we presented needs further development. A comprehensive study on how science students behave digitally, regarding their information and knowledge access and how they connect them socially, needs to be achieved. With that information, scientific models can be tailor-made to address misinformation risks among university students.

CONCLUSION

Digital educational methods are the bedrock for the future of higher education. Either from necessity or by innovation, they are prone to take over knowledge seeking students in this century. Schools, teachers and students need to comprehend how they are consuming and sharing their information, as digital innovations can be, as we extensively viewed, a double-edge sword.

University students are massively shifting their work into a digital basis. They are engaging in their activities in digital forums and social media and are exchanging information received and brought by those settings. The answers they seek in their queries for studying and for completing schoolwork, can be virtually found in any transmedia digital platform, regardless of any scientific background. Students are seeking to get information from those sources, as they can be more easily perceptible by them, as opposing to search in an hour-long online course or in a digital textbook.

As any other common social group, students are subject to misinformed. And if this pattern becomes more visible in an educational environment, there is no prediction for the outcome of their formation. We have seen how these elements spread. These can be as rough as creating logical outcomes that show absolutely what the students would like to: for example, exploiting an academic network to disseminate a particular scientific output that can be issued with faulty structures. By toll gating the major information gatherers, a common search engine can mislead students on the outcomes of simple questions.

Going beyond technology driven methods, specifically targeting students from the exact sciences, we highlight the importance of methodological study in scientific research. The incorporation of external issues to science, such as historical and cultural context while establishing a relation among them in the curriculum of scientific education, can have a positive learning effect. Students must understand what they are studying from a methodological point of view, being advised to be aware of good and bad information in nowadays' (mis)information age.

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KEY TERMS AND DEFINITIONS

Misinformation: The act of providing wrong information about a certain topic and/or to give false information.

MOOC (Massive Open Online Courses): A course of study made available over the Internet without charge to a very large number of people.

Online Education: Electronically supported learning that relies primarily on the Internet and digital platforms for teacher/student interaction and the distribution of essential syllabus materials.

Scientific Models: The production of a physical, conceptual or theoretical representation of a phenomenon that is difficult to observe directly.

Social Media: Digital interfaces (websites and applications) that allow users to create, share and comment contents or to participate in social networking.

ENDNOTES

1. Allo (2020) presented a pertinent analysis on the role of online learning during the 2020 COVID-19 pandemic in a university context.
2. As of April 2020, emergency status was still in effect in several European countries.
3. For example, in the case of EU-member Portugal, as of April 2020, all school degree systems adopted online learning status until further notice.
4. More on schools whose activities were affected by the Coronavirus pandemic as of April 2020 on the following website: https://en.unesco.org/covid19/educationresponse.
5. For a more insightful intake and review on MOOCs, two articles from Baturai (2015) and Lee (2018) emphasize the role of digital tools in today's education policies.
6. Daniel (2015) explores the idea of MOOCs as a business model, addressing its transmedia dimensions and applications. Yuan (2013) clarifies the implications of MOOCs in higher education settings.
7. Brundell (2016) and Ertmer (2012) address this issue, particularly expectations and outcomes that emerge from a range of influences on student teaching.

[8] Napal (2020) focuses on this point, from an educational sustainability perspective. Yacob (2012) reveals a study and a review on social, particularly, student awareness towards digital learning.
[9] On the connections of social media and creative thinking, see the works of Wagner (2012) and Corso (2013).
[10] More on the outtakes of this study can be found in Henderson (2015).
[11] As mentioned before, more on this study on university teaching in Henderson (2015).
[12] For reflections on fake news, and impact on undergraduates learning and research, see Rose-Wiles (2018).
[13] The relationship between science audiences (students and public), misinformation, and fake news are addressed in the review of Scheufele (2019).
[14] Correia (2019) presents a good article on the extension of the problem of selective sharing and mass opinion generalization.
[15] The outline addressed in this section follows the framework established in Sun (2016).
[16] For the original work, see McIssac (1996).
[17] Further details are addressed in Moore (2010).
[18] For the original paper, see Finch (2012).
[19] As reported by Sun (2016).
[20] The assessment on these factors, were based in the remarks by Moore (2010) and Finch (2012).
[21] About the conceptualization on the topic of the "knowledge gap", see original article by Tichenor (1970).
[22] Full presentation by the cited author can be found in Carpentier (2018).
[23] Extensive interpretation on the subject can be found when comparing the original articles, as Donohue (1975), and more recent works, such as Correia (2019).
[24] See articles from Sun (2016) and Moore (2010).
[25] The details of the study are found in Sun (2016).
[26] See Finch (2012), as mentioned before.
[27] This classification is based on the same findings as Sun (2016), as reported in McAuley (2010), adapted for this research.
[28] Original study can be found in Jordan (2014).
[29] Details on the outcomes and critical data analysis of the results in Reich (2014).
[30] As reported in Jiang (2016).
[31] The following classification is according to Hill (2013).
[32] The selected outlines about digital education were retrieved from the study cited on Henderson (2015).
[33] Part of this section is based on the conclusions of the study performed by Henderson (2015).
[34] As reported in Creighton (2013).
[35] Adapted and cited form the original work from Henderson (2015).
[36] As reported in Henderson (2015) and Richardson (2015).
[37] More on this issue can be found in Henderson (2015) and Macaskill (2013).
[38] According to Henderson (2015).
[39] As reported by Creighton (2013).
[40] This section follows the framework cited in Creighton (2013) and Richardson (2015).
[41] For better comprehension, see the study conducted by Creighton (2013).
[42] As acknowledged by Carpentier (2018).

[43] An academic approach on this is given by Moreira (2019).

[44] Wardle (2017) gives a good review on the transdisciplinary actions of misinformation, adapted for several frameworks.

[45] More on this in O'Connor (2019).

[46] On the subject on "Conformity Bias", see O'Coonor (2019).

[47] It is based on their findings in the book "The Misinformation Age" by O'Connor (2019).

[48] For the original paper, see Zollman (2007). A brief in depth description in given by O'Connor (2019).

[49] On selective sharing and how it can take various shapes in social interactions, see Weatherall (2018) and Correia (2019).

[50] A good example on the relevance and interaction with digital information is discussed in the study of Bigman (2019), when addressing the issues of selective sharing on social media.