

MATHEMATICAL STORYTELLING AND COVID-19. MADDMATHS: AN ITALIAN CASE STUDY ON THE AWARENESS OF THE ROLE OF MATHEMATICAL MODELS IN COMMUNICATING THE SARS-COV-2 EPIDEMIC

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Abstract

In winter 2020, the Covid-19 emergency explodes. From the earliest days, the Italian online magazine MaddMaths!, devoted to teaching and popularizing mathematics, decides to focus its attention on the mathematical aspects of the Sars-CoV-2 epidemic. The editorial choice is not to propose data and graphics but to publish articles for reflection, analysis, and dissemination on mathematical models as interpretative and political decision tools. Understanding the epidemic in order to combat it, is a scientific citizenship issue: citizens must have the tools to understand what is happening.

In this article, we analyze how MaddMaths! and its readers interacted during the first year of Covid-19. We apply textual analysis methodologies and techniques to about ten articles per month that MaddMaths! has dedicated to an in-depth study of the mathematical aspects of Covid-19. And then we do a quantitative analysis to understand the interest they have found in the public.

In contrast to the belief that the Internet is the place for fast and superficial communication, the existence of readers interested in deepening and understanding the mechanisms, including mathematical ones, of an epidemic, emerges. Although MaddMaths! does not usually cover health issues, its audience appreciated that the magazine has focused much of its work on communication. Communicating the mathematical models of a pandemic is a relevant form of health prevention. Understanding how Covid-19 evolves means learning to manage the risks associated with the Sars-CoV-2 virus.

Keywords: Engagement; Representations of mathematics; Mathematics and society, Covid-19; epidemic.

1 INTRODUCTION: A MATHEMATICAL MAGAZINE FACING THE SARS-COV-2 EPIDEMIC

For twelve years, the MaddMaths! animates the Italian cultural debate around mathematics, [1], [2]. The acronym MADD declares its purpose to speak of Applied Mathematics, Dissemination, and Didactics. Born in 2009, on the one hand, it offers readers interesting and original content, first-hand news, a refined and simple language that never allows logical and conceptual shortcuts. On the other hand, it offers contributions written by active mathematicians, people who do their research themselves and can speak with competence and complete mastery even of very advanced topics. And all this happens with lightness, in the high sense of Italo Calvino's American Lessons.

Its director, Roberto Natalini, over the decade underlined how «all scientists, but especially mathematicians, have the duty and responsibility to communicate with the rest of the world» and this responsibility is one of the cornerstones of the site in all its activities.

To give an idea of the impact, the public group MaddMaths!, Open to readers of the site, has 6,648 subscribers at the time of writing. There are an estimated 3,000 mathematicians active in Italy and if many could «basically not take too much interest in improving their public image», this means that the readers of MaddMaths! are now much more numerous than the mathematicians themselves, which gives us an indicator of the interest that the site has for many readers (only the most active get involved by participating in a Facebook group).

MaddMaths readers are mostly women (56%) and mostly young adults, especially if we consider them in the context of Italian society. Their distribution gives us a photograph of a population of university students, young researchers, or intellectual workers. The age largely under 54 reflects the habits of cultural consumption via the Internet in Italy.

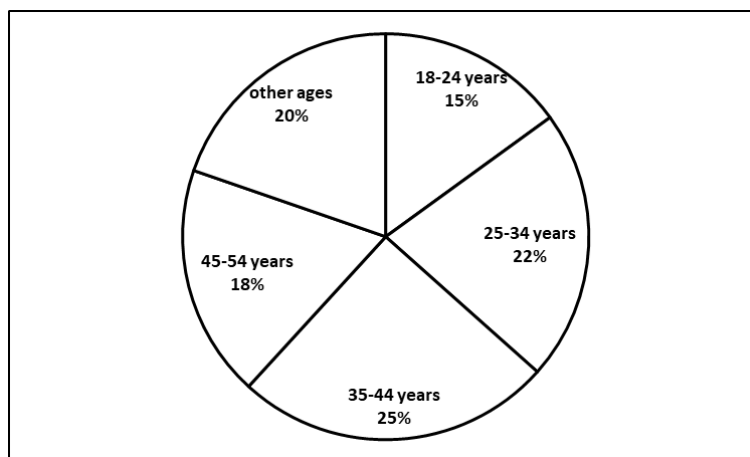


Figure 1. Visitors by age.

In the winter of 2020, the Covid-19 emergency explodes and on 10 March 2020 Italy is in lockdown, decided during the night by the Prime Minister, Giuseppe Conte. In Italian society, concern and fear of illness are growing on the one hand, and the need to understand and have correct information on the other.

Since the early days MaddMaths! decides to pay particular attention to the emergency and to do it as a mathematician. According to the role of science communication at the time of globalization [3], the editorial choice is not to propose data and graphics but to publish articles for reflection, analysis, and dissemination on mathematical models as interpretative and political decision tools. Understanding the epidemic to combat it is a scientific citizenship issue: citizens must have the tools to understand what is happening. In retrospect, it was a far-sighted choice: the Italian media landscape was invaded by excess data and graphics, [4] and a similar situation occurs in other European countries [5]. Instead, the interpretative tools were lacking. Some have spoken of a real infodemic, with an exaggerated proposal of quantitative information that has contributed to increased anxiety in a large part of the population. Many newspapers have chosen to consider their readers as children to be frightened rather than conscious citizens to be informed.

MaddMaths! chose the opposite way and bet on his readers' desire to understand. They searched for a language, terms and ways to communicate mathematics in the context of the crisis situation, according with [6], [7]. Of course, we cannot imagine that an online mathematics magazine has had an impact on Italian public opinion, but there is no doubt that many teachers, researchers, and intellectual workers, in general, have looked and still look at MaddMaths! as a credible point of reference for reflecting, analyzing and understanding the mechanisms, including mathematical ones, of the Sars-CoV-2 epidemic.

Before entering into the merits of MaddMaths!'s communication, we underline how the authors who write in the online journal are all mathematicians active in research and therefore, in principle, members of the academy. Despite the still rooted image of the "ivory tower" it was they, in the spring of 2020, and not the journalists, who understood a need for further study and understanding of what was happening. And they committed offering readers at least two insights a month on a topic that not everyone would have considered as typically mathematical at first. We can say that they experimentally tried to answer the questions: "Communicating mathematics: who, how, where, when and, above all, why?", [8], [9].

Finally, the editorial staff and collaborators of the magazine opened an important reflection on teaching mathematics in the times of the crisis, both at school and university level, [10]. And they have experimented with a way to make Covid-19 a gateway to mathematics education, [11].

2 METHODOLOGY: ACCESS DATA AND TEXT ANALYSIS

We have had access data to the site <http://maddmaths.simai.eu/> and to the Facebook group Madd:Maths! from which we extracted some quantitative information on site visitors, group members, and their reading habits.

Of this information, in the *Results* section, we will offer an overview of the last seven years of the magazine's life, in which the trend of visits and the habits of readers have stabilized compared to the growing trend of the start-up phase.

Concerning 2020, and in particular, to spring, we analyzed the behavior of visitors in response to the publication of posts (articles) on the Sars-CoV-2 epidemic.

Finally, we completed our work with textual analysis, from a purely qualitative point of view, of the aforementioned articles.

3 RESULTS

3.1 Significant growth of authors and readers

MaddMaths authors are overwhelmingly active mathematicians in their research area. The remaining authors are science communicators and journalists with professional activity in communication and mathematical information.

In the years 2014-2019, the publication activity had a physiological growth settling, starting from 2017, on four articles published per week. 2020, especially starting from March, saw a significant increase which brought the total number of articles published to 335, almost one per day. This increase is due to the commitment that the MaddMaths! it has given itself to provide mathematical information on Covid-19 and in particular to create awareness of the role that mathematical models have in the epidemiological response.

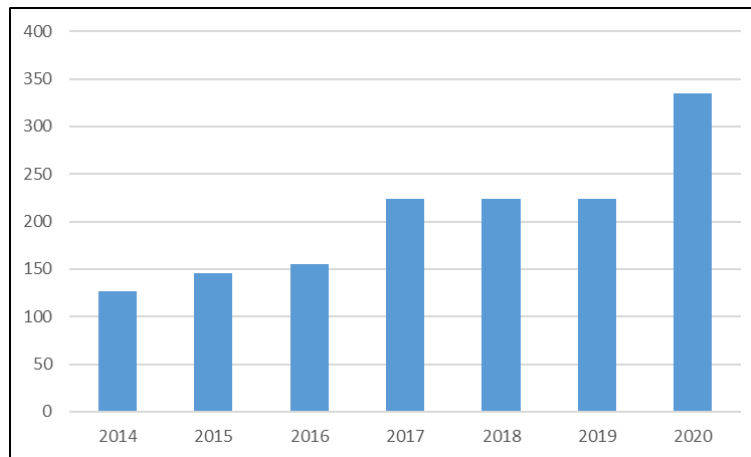


Figure 2. Posts per year.

The response of readers was not long in coming and 2020 saw the number of visitors more than double: if in 2019 they were 448,000, in 2020 they were 917,000.

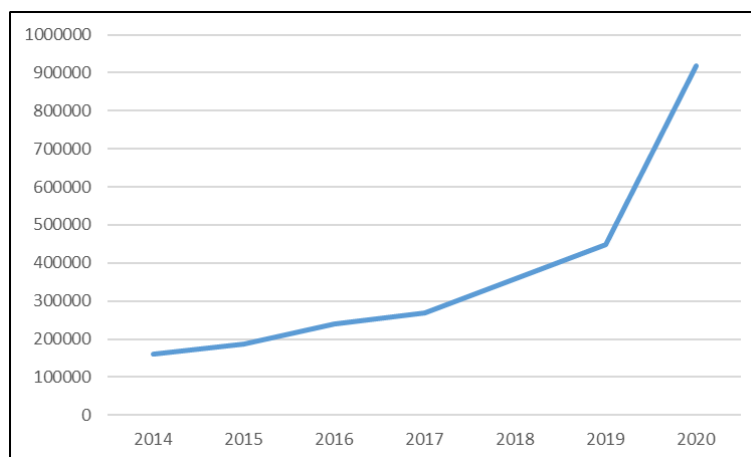


Figure 3. Pageviews.

Less relevant but still significant was the increase in members of the Facebook group Madd:Maths!. The difference between site visitors and group members must be attributed to the willingness to actively participate in dialogue and confrontation with the journal and its authors. The Facebook group is the meeting place where members discuss posts and where they ask questions that may become the subject of a future article in the magazine. A growth of 26% (from 5000 to 6300) in the members of the group indicates a request for active participation in the debate on the topics covered by the magazine. Since the journal has produced a significant number of articles on the mathematics of the SARS-Cov-2 epidemic, this increase is a positive response to the editorial policy adopted.

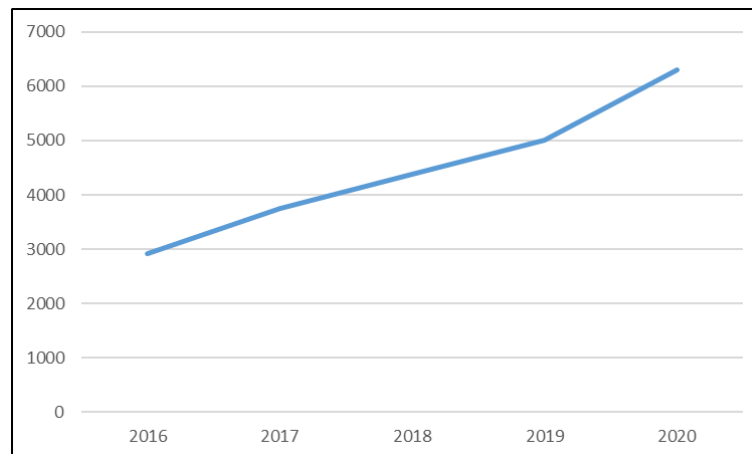


Figure 4. Facebook group members per year.

3.2 An interesting theme for the whole community

In 2020 MaddMaths! published 335 articles, 111 more than the previous year (+49%). We have classified them according to ten categories that have been present for some time in the magazine: applications of mathematics, insights, dissemination, obituaries of mathematicians, reviews of books and other works, school and teaching, mathematics and society, history of mathematics, university life, news. Specifically, this year we have introduced the epidemic and Covid-19 category.

The attention that MaddMaths! dedicated to the Sars-CoV-2 emergency it was distributed between the "epidemic and covid-19" category (52 articles) and the "school and teaching" category. In the latter, 32 articles from the #schoolcounts series appeared with which mathematicians reflected on the effects of the epidemic on the Italian school and on distance learning which affected almost all schools. Another 17 articles in the "university" category concerned the remote evaluation imposed by the situation that was going to arise. We can say that almost one in three articles published in 2020 concerned direct or indirect aspects of the epidemic.

Before analyzing the set of articles, let's make an observation on two of the articles in the "school and teaching" category. The first is the dossier that collects all the #schoolcounts articles and obtained 92 comments. The second is a detailed critique, signed by leading experts in mathematics teaching, of the Bortolato method and has attracted the interest of 97 commentators. We exclude both of these articles from the overall analysis due to their evidently exceptional nature.

In the following, therefore, when we indicate the category "school and teaching" we refer to the remaining 67 articles, which in any case make it the most present category in the magazine also during 2020.

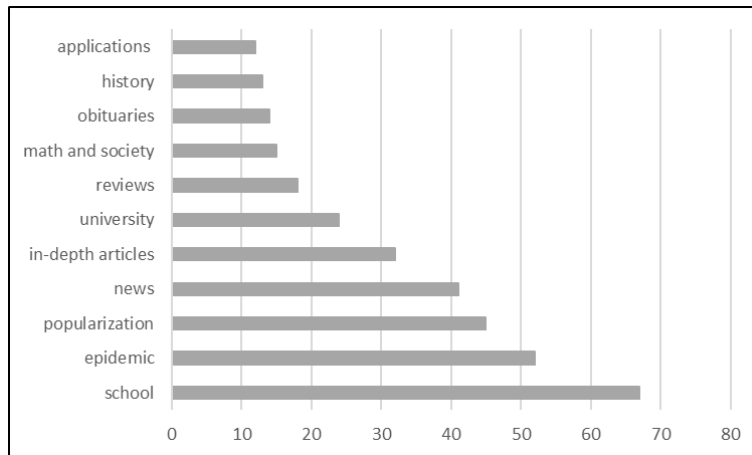


Figure 5. Post published in 2020.

If we divide the "school and teaching" category by highlighting #schoolcounts, we note even more clearly the editorial commitment to cover the various aspects of mathematical interest around the epidemic.

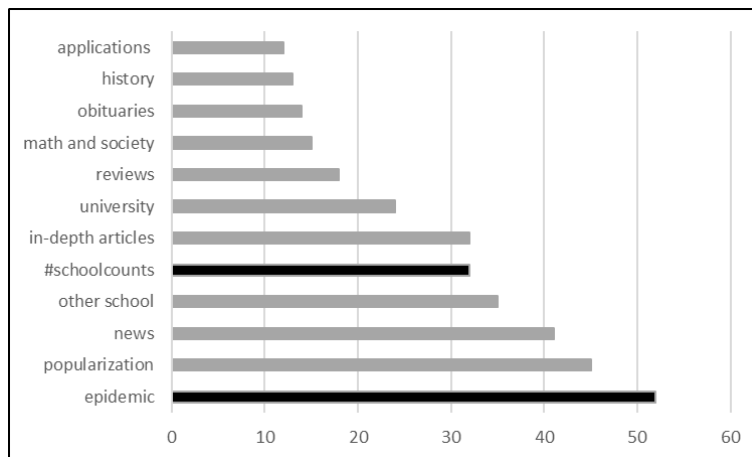


Figure 6. The two categories related with Covid-19.

Let's move now to consider the behavior of readers and in particular the willingness to interact actively with the magazine through comments. Most of the comments went directly to the "epidemic and covid-19" category, exactly 30% of the comments compared to 16% of the posts. This tells us that the MaddMaths community! she felt involved in a reflection on the mathematical models of the epidemic and more generally on the quantitative aspects of the same.

We observe, for non-Italian readers, that since the early stages of March 2020, the choice of the Italian government and authorities has been to strongly emphasize the communication of quantitative data (numbers of infected, hospitalized, hospitalized in intensive care, dead) perhaps at the expense of qualitative information more useful to increase the awareness of what was happening in the population. The choice of MaddMaths has intercepted a need and its readers have shown themselves to be in tune with it.

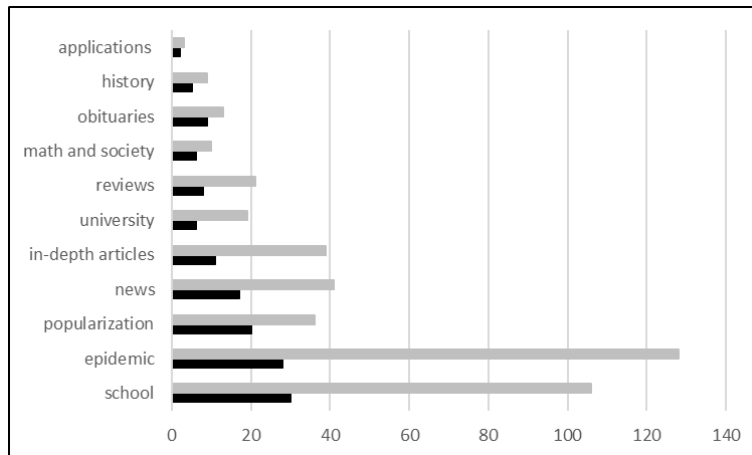


Figure 7. Black: posts which received comments. Grey: comments.

It is remarkable that while an article that does not talk about Covid-19 receives an average of 2.18 comments, the three categories involved ("epidemic and Covid-19", "school and teaching" and "university") receive an average of 3, 76: 4.57 if we limit ourselves to "epidemic and Covid-19". The articles on the emergency not only attract more interest, but also stimulate a greater desire to actively participate in the dialogue.

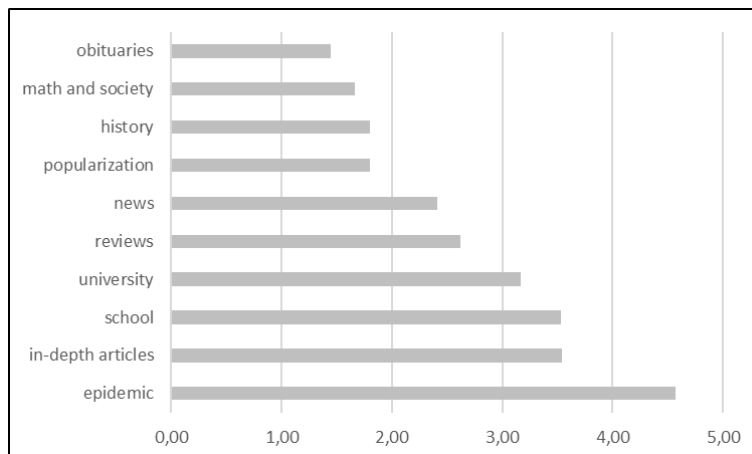


Figure 8. Comments per commented post.

4 CONCLUSIONS: THERE IS AN ONLINE AUDIENCE THAT WANTS MATHEMATICAL INSIGHTS

What we observed in the editorial choices and in the response of the public of MaddMaths! Magazine. In the course of 2020, indicates a demand of in-depth analysis on sensitive scientific issues.

MaddMaths! readers were not used to reading articles on health issues but despite this they welcomed the editorial choice of their magazine with active interest.

One of the tellings about the Internet is that those who read on the net look for fast texts for an impulse use. The 2020 year of MaddMaths! showed us that there is room for in-depth study.

Obviously we are not unaware that the Sars-CoV-2 emergency has provided a formidable motivation and has raised the level of attention of readers. Just as we know that MaddMaths! readers are still a niche of people very attentive to mathematics and therefore not representative of a wider audience. However, the time they spent to follow the reflections on the mathematical models of epidemics is significant (not exactly the first communication topic on the Italian mass media). And the attention they paid by interacting through comments on the magazine's website or in discussions in the Facebook group is relevant.

In the near future in which scientific questions will increasingly have an impact on society, the experience of MaddMaths! it shows us the way of a slow, continuous deepening over time, capable of entering into the specifics of the scientific method. We believe that this could also be an approach to be adopted on other issues: for example, the climate crisis. The next step is to understand how to broaden the niche and involve a wider circle of readers without sacrificing the necessary quality and in-depth analysis.

In our case, a key to broadening the public was the attention to what was happening to learning and teaching at school and university. The fact that the authors of MaddMaths! keeping alive the attention on the issues (new for Italy) of distance learning and evaluation in this new setting has certainly brought readers who then showed interest also in the more strictly mathematical aspects.

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REFERENCES

- [1] R. Natalini, “Maddmaths!: ovvero l'infinita ricerca di un nuovo modo di raccontare la matematica (e non solo quella applicata)”, *Archimede*, vol. 1, pp. 19-21, 2012.
- [2] R. Natalini, “MaddMaths! 10: Comunicare la matematica, un lavoro per tutti i matematici”, *MaddMaths!*, 2019. Retrieved from <http://maddmaths.simai.eu/divulgazione/maddmaths-10-roberto/>
- [3] P. Greco, D. Pitrelli, “Scienza e media ai tempi della globalizzazione”, Codice, 2009.
- [4] J. Milan Fitera, N. Abuín-Vences, J. Sierra Sánchez, “The coronavirus pandemic narratives in Italian digital media”, *Journal of Science Communication*, Vol. 20, Issue 02, 2021.
- [5] J. de Sola, “Covid-19 media coverage in Spain”, *Journal of Science Communication*, Vol. 20, Issue 02, 2021.
- [6] D. Gouthier, “Language and terms to communicate mathematics”, *Journal of Science Communication*, Vol. 1, Issue 02, 2002.
- [7] A. Capozzucca, “Communicating mathematics in Europe”, *Let. Mat. Int.*, 4, 2017.
- [8] S. Benvenuti, R. Natalini, “Comunicare la matematica: chi, come, dove, quando e, soprattutto, perché?!” , *Matematica, Cultura e Società. Rivista dell'Unione Matematica Italiana*, Serie 1 2, pp. 75-193, 2017.
- [9] D. Gouthier, “Understanding science publics”, *Journal of Science Communication*, Vol. 4, Issue 01, 2005.
- [10] N. Arcozzi, S. Benvenuti, A. Cattabriga, D. Gouthier, “Teaching Mathematics in Times of Crisis”, *ICERI2020 Proceedings*, 2020.
- [11] E. M. Mulenga, & J. M. Marbán, “Is COVID-19 the Gateway for Digital Learning in Mathematics Education?”, *Contemporary Educational Technology*, 12(2), ep269.