MathMemeThon: how mathematical memes bring teachers and students together during Italy's pandemic lockdown

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Introduction: a tale of two cultures

The global switch to distance education imposed by the Covid-19 pandemic in 2020 and 2021 dramatically exposed teachers' difficulties to engage students in a distance-learning setting, as acknowledged by recent studies (Bakker & Wagner, 2020; Fondazione Agnelli, 2021). Indeed, these difficulties are more related to the existing technological and cultural discontinuities between 21st-century learners and teacher-centred educators (Bronkhorst & Akkerman, 2016) than to the distance-learning setting enforced by the pandemic. Feedback collected from Italian teachers posting in social media groups on Facebook and from personal acquaintances evidenced that the majority of teachers simply moved their usual teacher-centred lessons from in-person to distance mode, resulting in one-way lessons with teachers lecturing passive students (often with no camera on), which dramatically failed in engaging learners. In other words, the pandemic just amplified malfunctions that were already there, making them clearly observable. It acted as the PCR, the Polymerase Chain Reaction used in molecular biology to amplify DNA samples: now these malfunctions are evident and we can observe them and act on them. One possible way to act on them, bridging the discontinuities and engaging students both in-person and in distance-mode learning settings, is by challenging the dichotomy between the two cultures represented by in-school formal learning and out-of-school informal learning. This can be done, among others, by importing a product of the out-of-school digital culture, such as mathematical Internet memes, into the in-school formal learning environment.

What are mathematical Internet memes?

Internet memes are digital objects pervasive on the Web (221 million occurrences of the hashtag #memes on Instagram in February 2022) created by Internet users adding original humorous captions to existing popular images. Mathematical Internet memes are mathematical mutations of Internet memes: they combine mathematical and memetic elements to produce hybrid representations of mathematical statements, endowed with an epistemic power to initiate argumentation processes among users inside dedicated online communities (Bini et al., 2020). Despite these evident potentialities, mathematical memes are still widely understudied in mathematics education.

The activity: theoretical framework, research question, methodology and results

In 2020, Bini and Robutti conducted an exploratory study on mathematical memes as boundary objects (Star & Griesemer, 1989) between the communities of students and teachers during in-person school activities. The purpose of this work is to move forward along this line of research, investigating if mathematical memes can "fulfil a bridging function" (Akkerman & Bakker, 2011, pp. 133) between students and teachers also in distance-mode settings. The study is guided by the research question: Can mathematical memes act as boundary objects between students' informal out-of-school culture

and teachers' formal in-school mathematical culture in distance-mode activities? Mathematical memes' boundary-crossing nature has been taken into account in two different ways in designing the activity: (1) the task design requested students to create a composite object, i.e. a mathematical meme *and* a presentation providing a brief insight into the mathematical content, and (2) during the activity the author acted as a boundary broker, facilitating the "processes of translation, coordination and alignment between perspectives" (Wenger,1998, p. 109). The result is MathMemeThon, a distance learning activity with mathematical memes, structured as a team competition inspired by a computer hackathon. The activity took place in the second quarter of the 2020/21 school year, involving 7 class groups of 9th grade students (15yo) and 2 class groups of 10th grade students (16yo), for a total of about 180 students and 6 teachers from 3 different institutes located in Piedmont, in the north of Italy. It developed in three online meetings of 2 hours each, where students teamed and competed creating mathematical memes and presentations, and sharing them online on Padlet walls. Students' productions were then presented remotely via WebEx to a jury of experts made up of teachers, Master and PhD students of mathematics, who judged the productions evaluating the mathematical and memetic content and the quality of the presentation. Memes were then shared on the project's Instagram page (https://www.instagram.com/lifeonmath/).

Observations of the interactions and feedback from teachers and students showed that, even in the distance learning setting, the hybrid language of mathematical memes succeeded in connecting the two communities: teachers appreciated the idea of communicating mathematics through an object "very close to the world of students", and students valued the fact "it was necessary to give importance to the mathematical content but at the same time to find the right idea to create the meme".

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