# Using Memes to Open Spaces for Critical Conversations about Mathematics

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## Abstract

For better or worse, teachers are not the only ones delivering messages about mathematics; media and social media routinely disseminate messages related to narrow views of mathematics and stereotypical portrayals of mathematicians. These messages can reinforce unproductive cultural beliefs and structural norms in mathematics education which has the potential to influence student achievement and motivation in mathematics. Thus, it is important that we, as a mathematics education community, begin to analyze, decipher, and scrutinize those messages. This article concentrates on creating spaces for students to hold conversations about mathematics through the use of Internet mathematical memes; since, messages generated from memes can be powerful and have the potential to influence one's mathematics experience and one's perceptions of who can become a mathematician. This article will demonstrate how incorporating memes in the classroom can invite students to discuss authentic uncensored thoughts, curiosities, and uncertainties about mathematics as well as the people who do well at it.

## Discussion And Reflection Enhancement (DARE) Pre-Reading Questions

1. What impact do you believe social media has on your students' mathematical experience?

2. Is it worth exploring different messages students are receiving about mathematics and the people who do well in it? Why?

3. How do you create spaces for students to openly reflect on and/or debrief their authentic thoughts, curiosities, and/or uncertainties about mathematics, how mathematics is taught, and who does well in it?

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# Using Memes to Open Spaces for Critical Conversations about Mathematics

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As young people navigate media, more specifically social media, they are routinely exposed to a variety of mathematical artifacts and messages, some of which support narrow perspectives and stereotypical portrayals of mathematicians (Benoit & Salopek, 2023; Hall, 2021; Hall & Suurtamm, 2020; Moreau et al., 2010). For example, the image of the "gifted" mathematician is pervasive in popular culture (Moreau et al., 2010; Wilson & Laterrell, 2001), but is synonymous with being crazy or a nerd. It is impossible to "protect" students from unsympathetic mathematical messages they may come across. With no formal space for young people to debrief these messages, thoughts or sentiments, students are left to their own devices as to if, how, and where they deliberate these messages. One concern is that unsympathetic messages can seem truthful if they are constantly replicated, frequently visible, and rarely critiqued (McGregor, 2019). If these narrowly defined representations of mathematics and the people who do well in it are internalized, it can be damaging to students' mathematics identity (Benoit, 2018; Benoit & Salopek, 2023).

In the same way discussions in mathematics classrooms can support students' understanding of the mathematical content (Michaels & O'Connor, 2015), we believe these discussions can support students in developing and sustaining expansive perceptions of mathematics and the people who enjoy it. By inviting students to select, share, and discuss mathematical memes, students are strengthening their critical mathematics media literacy and making meaning of the dominant, oppositional, and negotiated representations of mathematics (Kellner & Share, 2007). Opening space for students to discuss the societal narratives about mathematics they interact with every day, can help students negotiate their lived experiences with media artifacts (Alvermann et al., 2018).

The objective of these critical conversations is not to conform students to a teacher directed definition or a monolithic understanding about mathematics and its portrayal, though we do recognize the teacher's perspectives and actions have historically carried a great deal of weight (Behar-Horenstein et al., 1996; Gardee & Brodie, 2022). Rather, these conversations attempt to expand any limiting definition of mathematics and the people who "can" do it. In such discussions, students are the experts because they have the immediate and direct experience with popular culture (Appelbaum, 1995; Morrell, 2002). This means educators must learn how to relinquish authority and allow students to help facilitate classroom conversations. In turn, it gives educators of today an opportunity to "become more cognizant of ongoing popular culture curriculum and comprehend the relevance of public and professional discourse of mathematics education as an ongoing practice in and out of school" (Appelbaum, 1995, p. 46), a perspective later echoed by Bini et al. (2020).

Below we detail a mathematical task that was used as part of a research project to promote critical conversations about mathematics. Researchers Benoit and Salopek worked with students of teachers in their professional network to facilitate the task. Researcher Benoit conducted the activity with conversations while researcher Salopek observed with recorded notes. In particular, the researchers worked with Ms. Stanlee, a second year Caucasian-American mathematics teacher at Wakanda High School, a Brooklyn, NY public high school where 91% of the student population is Black or Hispanic. All pseudonyms for names and locations were inspired by students and reference Marvel's *Black Panther* movie. Conversations were held during the beginning months of the year, and were recorded and transcribed for further analysis using grounded theory methodology. Out of nineteen students, we chose to focus this article on four student examples that centered critical conversations about mathematics: Riri, an African-American female tenth-grade student, Shuri, an African-American female twelfth-grade student, Okoye, an African-American female tenth-grade student and M'Baku, a Hispanic male tenth-grade student.

## Task: What Does This "Meme" to You?

This task asked students to submit artifacts – Internet memes or graphics interchange format (GIFs) – about mathematics that they engaged with on social media or the Internet. It served as a window into societal discourse about mathematics and gave a chance to explore student perceptions about the nature of mathematics. These social media artifacts were used by researcher Benoit to stimulate a semi-structured critical discussion about mathematics where students openly reflected on their and their peers' authentic thoughts about mathematical stereotypes, curiosities, or uncertainties as they relate to the selected and presented memes. Questions used to drive conversation were inspired by the Critical Media Project (https://criticalmediaproject.org/) as shown in Table 1.

**Table 1**

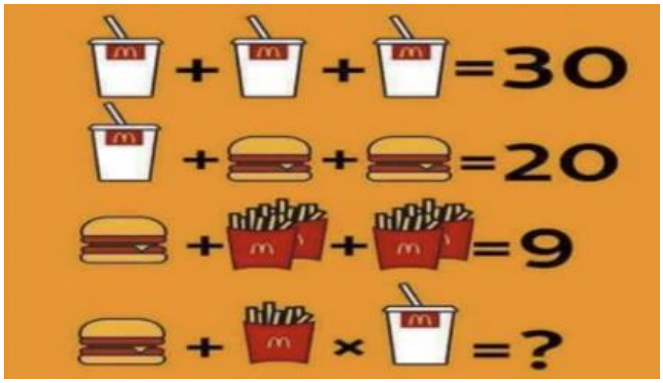
*Potential Semi-Structured Discussion Questions*

| **Questions** |
|---|
| What message(s) is displayed in your social media artifact? |
| Do you agree or disagree? Why? |
| How might other people understand this message differently than you? |
| Would you share this message on your social media account? Why or why not? |
| Have you seen other artifacts with similar message(s)? |
| Who would create an artifact like this one? |

### "Answers to these memes are tricky" – Riri's Content-Specific Meme

Riri began sharing a mathematics problem within a meme (Figure 1). Riri stated, "there are these like little math quizzes, it's like a McDonald's fry, and then a cup, and they ask—can someone help me figure this out?" Riri, talked about how these mathematics problem memes go viral quickly because, "people start arguing and debating over the answer." Riri continued to suggest that there were lots of different answers posted in the comment sections and described how invested online users were to figure out the answer. Ironically, as Riri was discussing her meme, students were simultaneously shouting out potential answers, further demonstrating Riri's point. Riri continued to explain, "answers to these memes are tricky; the mathematical problems themselves are simple but if you mess up, that answer is a choice."

**Figure 1**
*Riri's Meme*




In other words, having multiple answer selections that are aligned to multiple procedural misconceptions and mistakes raises students' indecisiveness. Students indicated that memes like this usually go viral as multiple online users are willing to engage and share. Students pointed out the comments are the most entertaining part, as users passionately argue to get their point across. Further, all students, even those who do not regularly participate in mathematics class, indicated they engage with such memes in virtual spaces (Schifman, 2013; Bini et al., 2020). Four students submitted a mathematics content specific meme (i.e., system of equations, order of operations, logic) that were also discussed but not in as much detail. One thing to note is that examples like this illustrate how mathematical content transforms school walls into popular culture, creating and defining new mathematical spaces where multiple people are engaging with the content and are so passionate that debates ensue.

Students during these conversations have the space to discuss, comment, question, editorialize through the images and messages shared - push against hegemonic culture in mathematics - not just accepting what is told but letting students explore and discover for themselves. Mathematical memes can be the catalyst for mathematical ideas to be elicited and for future research on the educational potential of these memes since these encounters can be observed (Bini et al., 2020). Implicitly, her meme expanded traditional notions of mathematics, enabling a wide audience (going viral) to grapple with complex mathematics (three variable systems of equations) while explaining, defending, and critiquing their mathematical reasoning. Here, mathematics is seen as accessible, engaging, and fun, and not simply sets of problems to solve.

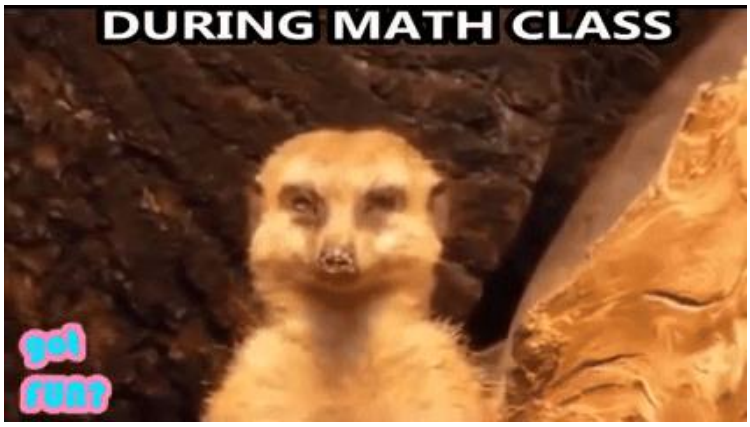
**"Math being boring is not a secret" – Shuri's GIF, Instructional Suggestions**

Shuri, presenting the GIF in Figure 2, began:

> Little lemur cats were pretending to be in math class. And some math teacher was like, 'If 4 equals *x* then we put *x* into the equation…' and one lemur cat is falling asleep because he's getting bored in the class.

Following Shuri's introduction, the class held an open discussion, where students had some initial time to make sense and interpret the GIF individually. Shuri began the discussion stating the message being portrayed is that "math is boring, and people struggle to stay awake. It implies that there is little interest in math." When probed further for other embedded messages, students collectively responded that they agreed with Shuri's interpretation of the meme. Most of the class articulated that they would share this on their social media accounts because "math being boring is not a secret," said W'Kabi. Shuri added, "Yeah, but it can also be an outlet for some that also feel math is boring, it could be relatable to other students." Shuri was expressing that memes can help validate students' feelings.

**Figure 2**
*Shuri's GIF*




As we continued talking, one important distinction became clear, students were saying the way mathematics was taught was boring, not mathematics itself. Students

expressed that mathematics should not be a lecture-based class (as illustrated in the GIF) but instead involve more student inquiry and exploration. "We should be doing things that are hands-on and figuring things out," said Nakia. Students seemed to be in favor of project-based mathematics where theoretical and abstract algorithms come to life as practical uses. The class was then asked who the creator of an artifact like this would be. Nakia responded, "this message was most likely created by students who clearly think mathematics is boring." Additionally, students were asked, "Which points of view were not represented in or omitted from this GIF?" Okoye expressed, "There are people who potentially enjoy math class." Shuri added, "Yeah people like yourself (Ms. Stanlee) and other mathematics professors and teachers. The GIF only represents the point of view of someone who shows a clear disconnection from the lecture. There are others who like math and prefer lectures." This example highlights our ability to see multiple perceptions and perspectives of mathematical artifacts, as they can be interpreted in a multiplicity of ways. Together we searched for alternative meanings and counter-narratives which helped us demonstrate that more than one perspective can simultaneously be true. While memes may have been created with an intended purpose and message, users ultimately have power to interpret messages the way they would like.

**"We're gonna need to use it when we're older" - Okoye's Call of Significance**

**Figure 3**
*Okoye's Meme*


As the conversation reached a lull, Okoye inserted Figure 3 into the discussion and shared, "There's ones like this, that show like a math problem and then they put it on the speed sign or stop sign. It was like they think this is how math is in life. Like you know, you need to solve it for everything." As the class laughed, Okoye was asked to further explain what she perceived the message to be. She explained, "teachers force it, they swear mathematics is everywhere." N'Jobu, added, "Yeah, that's what every teacher says. Like, we're gonna need to use it when we are older." Ramonda affirmed, "And sometimes they [students] will make fun of the way teachers say that we are going to need it for our life, but so many teachers have said it to us that we just take it as a joke now." From their commentary thus far, the meme questions the purpose of mathematics and is poking fun at teachers' overzealous ways of superficially promoting mathematics. Through the conversation, the students questioned not only the portrayals of mathematics in social media but also how mathematics teachers portray math as well. These particular critical conversations opened spaces for students to grapple with mathematics' relevance in their own lives.

N'Jobu then stated, "Yeah, like people say you need the Quadratic formula." Nakia followed, "Some people do need it; it depends on what you want." N'Jobu then claimed:

> Yeah, but most people don't need it when you think about it. All right, think about it, if you're working in a hospital. Then you would need it because you'll need to know the amount of medicine you put in, because you can put in the wrong amount and that person could die … But say you're doing clothing; you don't really need to know it, you're just designing something.

Namor interjected with an opposing thought, "nah, if you're rich you're going to need it 'cause you are going to need to know how to manage your money." The conversation grew silent and students did not come up with any alternative messages being portrayed. When asked who would create this meme, students said, "students making fun of teachers." While this meme shared some cultural views about mathematics teachers, about three-fourths of the class indicated they would post this meme on their social media accounts.

Though brief, this interaction between N'Jobu and Namor marks a moment in these students' lives where they interrogate the usefulness of mathematics as they contemplate real life applications. This will further be elaborated on in the discussion.

**"Like we've been saying … math is hard" – M'Baku's Image, Effort and Cumulative Nature of Mathematics**

As the class was ending, M'Baku quickly turned our attention to Figure 4 (his meme) containing Mr. Krab from SpongeBob Square Pants. M'Baku stated that everything is fine until someone says, math class is about to start. He and the class then began to laugh. When asked to clarify further, he suggested that the meme (indirectly) represents that mathematics is complicated and confusing. "Like we've been saying throughout this discussion, math is hard!" M'Baku asserted. M'Baku then explained:

> In eighth grade, I actually loved math. Like I found it so easy that all I had to do was just write it down. But now it's like, a lot more complicated and you have to use your memory and, like, ten different things.

When asked to say more, M'Baku acknowledged that he did not previously have to try and now he has to. He added, "Yeah, but before it was just like, do 20 questions really fast and you're done." He related his love for mathematics to the effort he had to exert. He stated that he previously loved mathematics because it was "easy" to him, and he applied little, if any, effort at one point. Mathematics is now requiring him to make more of an attempt, and consequently his love for mathematics is decreasing.

**Figure 4**
*M'Baku's Meme*


When asked if that was a bad thing, W'Kabi added, "Like, you just can't miss a day in geometry. You learn something every day." While the bell unfortunately cut the discussion shortly after, one thing to consider is W'Kabi's comments. In a class full of high school students belittling mathematics, we acknowledge W'Kabi could have easily said 'yes,' and presumably gotten laughs and admiration from his peers but he opted not to. Instead, he emphasized that effort is needed in mathematics learning and he conceptualized the cumulative nature of mathematics.

## Discussion and Lessons Learned

Though this was just a snapshot of our conversation, memes offered students an accessible and familiar format to reflect, allowing them to be honest and vulnerable. Overall, students expressed their perspectives about mathematics, how it should be taught, its relevance (or lack thereof), as well as juxtaposed their experiences with mathematical discourse. While there were several notable takeaways, we focus this debrief on the four lines of discussion we deemed most helpful for others seeking to implement similar activities within their classrooms.

First, in Shuri's discussion, students identified the memes as relatable and something that parallels previous experiences. While the memes themselves may be created as a joke, or social commentary, these students saw clear cultural icons and connected the mathematics in the meme to their classroom experience. Furthermore, students demonstrated intentionality in their decision to share or not to share memes on social media. In other words, sharing memes can represent an intentional idea or attitude students may want to voice about mathematics; recognition of what that discourse is could be a telling artifact about their math identity. We must expand our discussion about Internet memes as solely humorous to potential ideological artifacts (Benoit & Salopek, 2023).

Second, mathematics content-specific memes seem to be an untapped resource in our classrooms. Recent research by Bini et al. (2020) found that mathematical memes create openings for collective meaning-making of mathematical ideas. Mathematical concepts and content are evident in our social realms and can be a powerful tool in connecting students' own daily experience to the content being explored in the classroom. This aligns to Appelbaum's (1995) suggestion that "teachers

can bring [memes] into their classrooms and utilize it as a tool to enrich, motivate, provide social context, and heighten the significance of mathematics" (p. 44), such has been the work of Bini et al. (2022), as they explore the creation and usefulness of meme templates for messaging in mathematics spaces. For example, Riri's meme was a cohesive blend of joy and content as students were drawn to solve it throughout the class. One possible extension could be to leverage the comments left on mathematical content-specific memes for mathematical exploration. For example, Riri's meme could be extended to say: Derek left a comment on this meme stating the answer is 60. Jennifer left a comment stating the answer is 25. Jacqueline stated they both were wrong but could not figure out where they made their mistake. Such questions get students to explain their reasoning, critique other answers as well as tease out common misconceptions, thus sources for error analysis that could be imposed into the mathematics curriculum. This is an opportune time to reinforce the nature of mathematics and who can do it; just because there are errors does not mean an individual is not a math person or cannot do math.

Third, though brief, M'Baku's comments were telling, in that the love of mathematics was inverse to the effort he was asked to put forth. This tension between effort and mathematical adoration aligns with previous research on mindsets (Haimovitz & Dweck, 2017; Hwang et al., 2019). The impression is that if you have the "ability," you should not need to try hard, and if you need to try hard, that is a sign that you do not have the ability. Ironically, he illustrates that mathematics identity can be fluid. Mathematics was "easy" and now it is "hard." Seeing identity as a collection of mathematical moments, whether good or bad, begins to help students reconceptualize who is allowed to do mathematics, pushing against the popular representations of "mathematician."

Finally, referring to Okoye's example (Figure 3), students want relevant and interesting applications of mathematics. While teachers continuously stress the importance of mathematics, students admittedly perceive it as mundane suggestions. Students are tired of hearing, "you are going to need it when you are older," and waiting for the arbitrary day when they will use it. Namor, like so many students, trivially identified managing money as a practical application of mathematics (Brenner, 1998; Yeo, 2010). Additionally, N'Jobu mentioned the need for hospital workers to be familiar with the quadratic formula (as a proxy for mathematics beyond arithmetic), while simultaneously suggesting that clothing designers may find the same concepts unnecessary. With regard to the quadratic formula, specifically, we find it far more likely a clothing designer would implement this mathematical concept, as compared to a hospital worker (Bakan, 2000). This does highlight, though, that advanced mathematics is deemed necessary for some careers (e.g., doctor, nurse) but not used in other careers (e.g., clothing designer).

While we feel as though the life and death sentiment was used to signify the importance of mathematics, such trivial examples like Namor's or extreme examples like N'Jobu's illustrate an ambivalence for mathematics application. Researchers such as Skovsmose (2013) have noted that some mathematical curricula lack the authenticity of "real" application. Skovsmose states:

> Applications of mathematics are difficult to observe and therefore to express an opinion on ... When the children fail to realize that mathematics is in action, they don't have any chance to question their opinions about it. When they do not realize that they are using mathematics, their image of the subject as belonging only to a textbook is not challenged (p. 96).

Taking the time, within a classroom, to explicitly create space for students to locate, introduce, and explore mathematics with memes allows for a larger conversation about what mathematics is, how it can be represented, and who can do mathematics. The students discussed in the above vignettes were given precisely that opportunity, allowing them to express opinions about who the likely meme creator was, in which jobs the mathematics may be more complex, and how "easier" mathematics may be more enjoyable. Without this experience, our students at Wakanda High perhaps would have been left to study mathematics through the lens of another, not for themselves.

## Facilitation Considerations

As teachers are interested in getting to know their students, consider how memes can be used in the classroom to open dialogue about mathematics and students as doers of mathematics. This flexible and versatile task honors creativity and playfulness rather than simply answering questions about their previous mathematical experiences. This task is relatively

uncomplicated and straightforward to facilitate and can be revisited multiple times throughout the year, such as intermediate tasks when students are going on or returning from school breaks. Further, student-generated memes can be good formative assessments and allow teachers to examine the shifts students are making about their perceptions of mathematics.

The discussions can be arranged in several fashions depending on classroom size and time constraints. It could be facilitated as gallery walks, group discussions, or individual presentations depending on the teacher's desired goal. Additionally, as you read, we are sure you noticed some missed moments, where deeper follow-up questions could have been asked to elicit more student thinking. For this facilitation, we erred on the side of hearing many students, but moving forward we suggest selecting a few students and going into depth. These discussions also involve a great deal of vulnerability and trust as you are inviting the whole student into the mathematics classroom. As students share their raw, authentic thoughts, we urge for care and compassion to keep the critical conversations a safe space. As the year continues, teachers can have ongoing critical conversations about mathematics that challenge limiting mathematical associations, possibly helping students construct alternative ideas and reimagine their experiences moving forward. Additionally, while the ensuing discussion is taking place, teachers can make notes illuminating thoughts and messages, and examine how their routines and procedures support or challenge their notes.

## Conclusion

We offer this task to be critiqued, modified, and iterated, as a support for students' and teachers' reflective practice to engage in ideological questions around social media and mathematics. Today, youth are everyday consumers of social media with routine access and availability to memes containing messages about mathematics. While we believe that young people are not gullible and have the capacity to practice discernment, we also believe that there is an opportunity to activate students' critical lenses and sharpen their attunements to mathematical values, stereotypes, and who is creating these messages. Each of these images come with layers of meaning – some meaning only unlocked through discussion with others, where multiple perspectives can be voiced. Students can become critical consumers about the messages they encounter and hopefully assist each other in constructing positions they may personally occupy (Alvermann et al., 2018; Morge, 2007).

Teachers have a role to play in these conversations. While the adults in these conversations help students build understanding about the messages presented and how they relate to the world of mathematics (both in and out of the classroom), they can also gather much needed information about how imposed routines and procedures can shift to better engage and support these learners. It is, therefore, not enough to explore the thoughts and feelings of only students who identify, present, and discuss mathematical memes. Studies focused on parents, teachers, and pre-service teachers are also needed. These new investigations would lead to a more complete understanding of the ways mathematical memes can and should be utilized to counter popular mathematical tropes (e.g., "math is hard," "only smart people do math") and deepen mathematical understanding and appreciation. As Gutiérrez (2013, p. 2) stated, "Not attending to identity and power means we are at best fooling ourselves about future prospects and at worst likely to ensure that mathematics education will be unable to realize its full potential for the 21st century." Normalizing critical conversations about mathematics, utilizing student selected mathematical memes, can be a step in the right direction.

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## Discussion And Reflection Enhancement (DARE) Post-Reading Questions

1. What messages are students receiving about mathematics from popular culture? How do you know?

2. Attached is a link to our website https://mathmemeteam.com/ where we have designed three research activities (Coding Memes, Sharing Memes, and Submitting Memes), as well as educational resources to support educators in facilitating discussions within their own environment. What is helpful from these resources? What is missing that you wish was there?

3. When and how often will it be beneficial to explore the mathematical messages students are receiving about mathematics from popular culture?