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Reimagining the Mathematics Classroom through Magical Realism

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Abstract: This paper explores magical realism as a theoretical lens for analysing mathematics classrooms. Traditional frameworks often overlook the complexities of teaching and learning, focusing solely on measurable aspects. Inspired by magical realism – a literary genre blending the fantastical and the everyday – I propose a new perspective on how abstract mathematical concepts connect with students' lived experiences. This approach values ambiguity emphasises productive struggle, and advocates for culturally responsive pedagogy. It challenges linear views of learning, recognising its non-linear, insight-driven nature. While conceptual, this framework offers potential for transforming classroom practices, though further empirical research is needed to examine its impact.

Keywords: magical realism, mathematics education, classroom observations

Introduction

Recent years have seen a growing recognition of the need for more nuanced approaches to observing and analysing mathematics classroom practices (see Boston et al., 2015; Ingram et al., 2018; Schlesinger & Jentsch, 2016). While traditional frameworks, often focused on measurable outcomes and instructional quality, have provided valuable insights, they can struggle to capture the complex realities of teaching and learning. As our world becomes increasingly interconnected and unpredictable, these models appear inadequate for cultivating the creativity, critical thinking, and interdisciplinary engagement that contemporary learners require. In this paper, I propose an alternative framework that invites us to rethink the mathematics classroom.

Magical (also magic) realism, a literary genre blending the fantastical with everyday reality, serves as a powerful metaphor for understanding the abstract nature of mathematics and its connection to students' lived experiences. This perspective encourages a move beyond conventional observational methods, which often emphasise procedural fluency or conceptual clarity, to consider how mathematics intertwines with students' diverse backgrounds and experiences. An inspiring example of this connection can be found in Jungic's (2021) discussion of *The Raven Legend,* a Haida myth, illustrating how ethnomathematical concepts, such as infinity and limits, are smoothly woven into a magical narrative. By revealing how abstract mathematical ideas are embedded within cultural stories, Jungic's work demonstrates the potential of using magical realism to connect mathematics to students' cultural and cognitive lives.

The potential of this approach lies in its capacity to challenge the rigid structures of current observational/analytic models, which often privilege measurable achievements over more subtle dimensions of learning. A magical-realist lens allows for exploring the intersection between the abstract and the tangible, revealing how students' diverse cultural backgrounds and personal experiences engage with mathematical content. This perspective shifts the focus away from a narrowly technical view of pedagogy, promoting instead a more culturally responsive, imaginative, and transformative approach to mathematics education.

The following sections begin with a review of existing frameworks for observing mathematics lessons, concentrating on instructional quality, student engagement, cognitive demand, and equity. This analysis highlights the limitations of traditional models, particularly their tendency to emphasise technical outcomes over deeper learning processes. The paper then introduces the concept of magical realism as a theoretical lens for understanding the complexities of the mathematics classroom and examines how abstract mathematical concepts become integrated into students' lived experiences. Subsequently, the discussion explores the implications of applying magical realism to classroom observation, particularly in terms of fostering a deeper appreciation for the blurred boundaries between real and imagined mathematics, ambiguity, cultural responsiveness, and non-linear learning trajectories. The conclusion offers reflections on the transformative potential of this approach for developing more inclusive, creative, and meaningful mathematics education, and suggests potential pathways for future research and practical application.

Observing and Analysing Mathematics Lessons

Observing and analysing mathematics lessons has become an essential tool for both research and teaching, offering insights into instructional quality that student outcomes alone cannot capture. This process provides a dynamic view of how teachers engage with students and implement pedagogical strategies, directly influencing student participation, cognitive development, and equitable learning opportunities (Doabler et al., 2021; Schoenfeld, 2013). The need for such analysis arises from the inherent complexities of effective mathematics teaching. In particular, analysing lessons sheds light on how well teachers create culturally responsive learning environments that connect mathematical concepts to students' backgrounds and experiences, a practical necessity for effective teaching (Aguirre & del Rosario Zavala, 2013; Marshall et al., 2023). Such an analysis is critical for promoting engagement and equity by ensuring students' cultural knowledge and community contexts are integrated into mathematics instruction.

Research has long established that teaching is culturally situated, with both explicit and implicit assumptions about ability shaping instructional practices (Andrews, 2009a,b). Analysing mathematics lessons allows teachers and researchers to examine variability in teaching quality across different settings. This is essential for identifying disparities in instructional practices, ensuring that students from diverse backgrounds have equitable access to high-quality mathematics instruction (Bostic et al., 2021; Kohen & Borko, 2022). Additionally, lesson observation and analysis provide real-time feedback on the effectiveness of professional development programmes, highlighting how pedagogical interventions impact teaching practices in authentic settings (Doabler et al., 2021). These insights are crucial for broader efforts to address educational inequities and ensure that all students benefit from effective mathematics instruction (Praetorius & Charalambous, 2018).

The literature offers various frameworks for observing mathematics lessons, each with different dimensions and foci. Below, I synthesise what I interpret as the key patterns across these frameworks, highlighting the core aspects that should be prioritised during classroom observations. Various review articles compare observation frameworks for mathematics classrooms across different educational levels, including early years (e.g., Cerezci, 2020), primary and secondary (e.g., Boston et al., 2015; Praetorius & Charalambous, 2018), and post-secondary education (e.g.,

Anwar & Menekse, 2021). Readers interested in exploring these discussions further are encouraged to consult these articles.

Instructional Quality and Pedagogy

At the core of effective mathematics teaching is instructional quality, which refers to how well teachers convey both procedural and conceptual understanding. 'Good' mathematics instruction strikes a balance between developing students' procedural fluency (knowing how to solve problems step by step) and promoting a deep conceptual understanding that helps them grasp the underlying principles of mathematical concepts (Andrews, 2009b; Praetorius & Charalambous, 2018). When observing lessons, it is important to evaluate how effectively teachers use their subject matter knowledge and pedagogical content knowledge to present mathematics in ways that are accessible to all students. This includes the teacher's ability to break down complex concepts into manageable parts, use appropriate examples, and apply a range of instructional strategies (Ball et al., 2008; Rowland & Turner, 2007). For example, teachers might use models or representations to make abstract ideas more concrete or employ analogies that link new content to students' prior knowledge. Classroom management is another vital aspect of instructional quality. A well-managed classroom creates a structured environment that allows students to focus on learning without distractions. Effective classroom management ensures smooth transitions between tasks, minimises off-task behaviour, and cultivates a positive atmosphere where students feel safe to participate and take risks with their mathematical thinking (Ndihokubwayo et al., 2020). Furthermore, the skilful use of questioning, scaffolding, and formative assessments enables teachers to continuously check for understanding and adjust their teaching to meet the needs of their students (Andrews, 2009a,b; Charalambous & Praetorius, 2022).

Student Engagement and Participation

High-quality mathematics instruction is characterised by active student engagement, where students not only pay attention but also interact meaningfully with the mathematical content. Observations should focus on how lessons create opportunities for students to engage in mathematical discourse (e.g., articulating their reasoning, asking questions, and solving problems collaboratively with peers) as this helps clarify thinking and address misunderstandings, both crucial for deep learning (Aguirre & del Rosario Zavala, 2013; Gleason et al., 2017). Equitable access to learning is

another key aspect, with teachers differentiating instruction to meet diverse learner needs, such as adapting tasks, using varied questioning techniques, or providing additional supports like visual aids or manipulatives (Marks et al., 2021). This ensures that all students, regardless of ability, are challenged appropriately and have the opportunity to succeed. Furthermore, several frameworks consider how teachers encourage participation from all students, not just a few vocal individuals, using strategies such as small group work, think-pair-share activities, or rotating roles within groups to ensure everyone contributes. A classroom culture that values every student's input is essential, encouraging a sense of belonging, and encouraging even the more reluctant students to engage.

Cognitive Demand

One of the most critical aspects of mathematics instruction is maintaining high cognitive demand throughout lessons, which refers to the level of intellectual engagement required by tasks, ranging from simple memorisation to deep problem-solving that involves reasoning, justification, and critical thinking. Research shows that maintaining high cognitive demand is essential for fostering students' mathematical thinking and understanding (Bostic et al., 2021). Analytical frameworks typically assess the complexity of the tasks given to students, determining whether they are merely recalling facts and procedures or being challenged to apply concepts in new contexts. High-quality tasks are thought to encourage students to reason, make conjectures, and solve open-ended problems with multiple pathways to solutions (Charalambous & Praetorius, 2022). It is also important to examine whether teachers allow students to grapple with difficult tasks, rather than simplifying them too quickly, as this productive struggle is key to deep learning and developing perseverance and resilience in problem-solving (Gleason et al., 2017). Moreover, effective cognitive demand involves providing scaffolding to support students as they tackle complex tasks, using strategies such as guiding questions, worked examples, or collaborative learning opportunities, without diminishing the challenge. Striking this balance between support and challenge is crucial for maintaining high cognitive demand and helping students build strong problem-solving skills.

Equity

Equity in mathematics instruction is essential to ensure that all students, regardless of background or ability, have access to high-quality

learning opportunities. Therefore, a number of frameworks focus on whether the teacher creates an inclusive classroom environment that reflects the diverse cultural backgrounds and experiences of students. This involves using culturally sustaining pedagogies, which integrate students' cultural knowledge and community experiences into the learning process, making mathematics more relevant and meaningful to their lives (Marshall et al., 2023). In addition, observers evaluate how teachers differentiate instruction to meet the varied needs of learners. Equitable teaching is not only about offering different levels of challenge but also about recognising and valuing the unique contributions each student brings (Xenofontos et al., 2024). Culturally responsive teaching practices, for instance, affirm students' identities and validate their mathematical thinking, especially for those from marginalised or underrepresented groups (Nolan & Xenofontos, 2023; Yeh et al., 2020). This might include linking mathematical problems to real-world contexts relevant to students' lives or using examples that reflect their cultural experiences. Equity also extends to classroom participation, where observers should ensure that all students are given opportunities to engage meaningfully with the material. This includes inviting quieter or less confident students to participate and structuring group activities to ensure equal contributions.

Assessment

Assessment plays a vital role in mathematics instruction, providing teachers with insights into students' understanding and guiding instructional decisions. It is important to focus on how teachers use both formative and summative assessment to support student learning. Formative assessment practices are particularly valuable for gauging students' understanding during lessons and allowing teachers to adjust their instruction in real-time to meet students' needs (Doabler et al., 2021). This might include questioning techniques, exit tickets, or informal checks for understanding throughout the lesson. Another key aspect is how teachers provide feedback (Andrews, 2009a,b). Effective feedback is timely, specific, and actionable, helping students identify where they went wrong and how they can improve. It's important to note whether teachers create a feedback loop that encourages students to reflect on their mistakes and make corrections (Charalambous & Praetorius, 2022), while also promoting a growth mindset by framing mistakes as learning opportunities rather than failures. Summative assessments, which take place at the end of a unit or lesson, are equally important for evaluating overall student performance. It is crucial to consider whether these assessments align with the lesson's

learning goals and whether they assess both procedural fluency and conceptual understanding. The use of differentiated assessments is also important to ensure that all students, including those with diverse learning needs, have a fair opportunity to demonstrate their understanding (Marks et al., 2021). Finally, it is desirable for assessment practices to align with equity goals by being culturally responsive and ensuring that they do not disadvantage students from diverse backgrounds. It is essential to assess whether the teacher uses a variety of assessment methods to capture the full range of students' abilities, ensuring all students have the opportunity to succeed (Yeh et al., 2020).

In Search of Alternative Paradigms

Existing frameworks for observing and analysing mathematics lessons provide valuable insights into instructional quality, cognitive demands, student engagement and participation, equity, and assessment. They enable researchers and teacher educators to assess how well teachers convey mathematical concepts, manage classroom dynamics, and implement culturally responsive teaching practices (Aguirre & del Rosario Zavala, 2013). These frameworks support efforts to ensure equitable learning experiences by encouraging differentiated strategies that promote student participation across diverse learning needs (Bostic et al., 2021). However, while they offer effective tools for improving the technical aspects of teaching, they often focus on immediate, measurable outcomes, without fully addressing more complex, intangible dimensions of education. Specifically, they may not document creativity, interdisciplinary thinking, or critical problem-solving skills that are essential in an increasingly complex world. In many cases, these frameworks can be used to enhance the 'how' of teaching but do not deeply engage with the 'why', such as the reasons students learn in particular ways or how learning connects to larger life challenges. Moreover, many existing observational protocols prioritise easily measurable aspects, such as classroom management or student participation, but often overlook deeper cognitive processes, particularly those specific to mathematics. As Schlesinger and Jentsch (2016) argue, focusing on these surface-level observations can lead to overlooking critical elements like how mathematical reasoning is developed through tasks that promote cognitive activation. These gaps highlight the need for frameworks that balance both observable behaviours and the more abstract dimensions of learning, such as nurturing creativity and deeper problem-solving skills.

This calls for alternative paradigms that challenge the boundaries of traditional education and shift the focus to more holistic approaches that promote critical inquiry, engagement, and student autonomy. A more nuanced framework might integrate both general and subject-specific aspects of teaching, providing a richer evaluation of instructional quality. Such approaches would not only complement existing methods but also address their limitations by encouraging creativity, interdisciplinary thinking, and problem-solving skills, all of which are essential in preparing students for an uncertain future. With this in mind, I turn to an unconventional source, that of literary theory, to explore how the concept of magical realism may offer novel insights into reimagining the mathematics classroom and how to observe and analyse lessons. Although seemingly remote from mathematics education, magical realism provides a framework that challenges conventional notions of reality and structure. In a similar way, a reimagined approach to mathematics observation could blend technical rigour with creative thinking and interdisciplinary connections. This shift could help educators not only to assess but also to inspire transformative learning experiences, bridging the gap between instructional practice and the broader purposes of education.

Magical Realism

Magical realism is a literary mode that blends fantastical elements with the everyday world. Unlike pure fantasy, where magical events take place in entirely separate realms, magical realism integrates these elements into familiar, often ordinary settings. For Arva (2008), magical realism challenges our understanding of the world by presenting magical occurrences as natural, everyday events. In such narratives, neither the characters nor the readers receive explanations for these supernatural events, emphasising their seamless integration into reality. In turn, Asayesh and Arargüç (2017) describe this blending of the magical and the real as a key feature of the genre, one that encourages readers to reconsider the boundaries between reality and the supernatural.

The term ‘magical realism’ was first coined by German art critic Franz Roh in 1925. However, it gained significant traction in literature, especially in Latin American fiction, in the mid-20th century, when writers like Gabriel García Márquez and Jorge Luis Borges pioneered the genre. These authors used magical realism to explore political, social, and historical issues in their countries, often critiquing colonialism and authoritarianism (Bowers, 2020; Ngom, 2020). This intersection of the magical with the socio-political gives

magical realism its unique power, making it a potent tool for storytelling in postcolonial contexts.

Characteristics of Magical Realism

Magical realism is defined by several key characteristics that distinguish it from other genres. One of its most notable features is the seamless integration of magical elements into a realistic setting. Bowers (2020) notes that magical realism treats the supernatural as a normal part of the characters' world, rather than something out of place. This is exemplified in works like García Márquez's 1967 novel *One Hundred Years of Solitude,* where magical events, such as levitations or hauntings, are accepted without question by the characters (Ferrer, 2012; Sharma, 2021).

Another important characteristic is ambiguity and reader hesitation. Arva (2008) explains that magical realism creates a sense of uncertainty for the reader, making it difficult to distinguish where reality ends and magic begins. This ambiguity is essential, as it invites readers to question the nature of reality itself, in line with the genre's broader philosophical themes around perception and truth (Dethridge, 2009; Hegerfeldt, 2002).

A third feature is the presence of mythical and spiritual elements. Magical realism often incorporates local myths, folklore, and religious beliefs into its narratives. Danow (1995) points out that by drawing on non-Western belief systems, magical realism resists the rationalist frameworks that dominate much of Western literature. This use of indigenous or non-Western mythologies allows authors to critique colonial histories and present alternative perspectives on reality (Danow, 1995; Karimov, 2022).

Additionally, magical-realist works often disrupt traditional concepts of time and space. Linear time is frequently ignored, with stories moving fluidly across different periods and realities (Flores, 1955; Cvijanovic, 2020). Cvijanovic (2020) points out that this fluid treatment of time and space reflects the hybrid identities of postcolonial societies. In Salman Rushdie's 1981 novel *Midnight's Children,* for instance, time stretches and contracts in response to the protagonist's magical abilities (Sharma, 2021).

Finally, magical realism is closely tied to political and social critique. Moudileno (2020) observes that many magical-realist works use the blending of the magical and the real to comment on socio-political tensions in postcolonial societies. The genre's capacity to merge different realities allows for nuanced critiques of power dynamics, particularly those rooted in colonialism (Moudileno, 2020; Ngom, 2020).

Magical realism, as a literary mode, offers a unique way of understanding reality. It challenges our perception of what is real and possible, by integrating magical elements into the everyday world. Through its blending of the fantastical and the mundane, its fluid handling of time and space, and its engagement with socio-political critique, magical realism remains a powerful tool for writers worldwide. As seen in the works of Gabriel García Márquez, Miguel Ángel Asturias, Salman Rushdie, Toni Morrison, and Ben Okri, the genre continues to offer a compelling way to explore the complexities of history, culture, and politics (Danow, 1995; Ferrer, 2012).

Magical Realism as a Theoretical Lens for Observing Mathematics Classrooms

In search of alternative paradigms for understanding mathematics teaching and learning, I propose drawing on magical realism as a novel theoretical lens for observing and analysing mathematics lessons. Traditionally, frameworks for classroom observation focus on assessing instructional quality, cognitive demand, and student engagement, with an emphasis on measurable outcomes and immediate pedagogical effectiveness (Bostic et al., 2021; Charalambous & Praetorius, 2022). However, such approaches often overlook the more subtle, multifaceted realities that shape both teaching and learning. Magical realism offers a way to transcend these limitations by blending the concrete and the abstract, the real and the imagined, and the structured and the intuitive in ways that resonate with the complexities of the mathematics classroom. In the following pages, I outline my vision for using magical realism as a theoretical lens, detailing its dimensions and providing illustrative vignettes. These vignettes are not directly sourced from the cited literature; instead, they draw on summaries and rephrasings of work by other scholars or creatively reimagine classroom incidents inspired by colleagues' writings, incorporating elements of magical realism to bridge the mundane and the extraordinary.

Blurring Boundaries : Real and Imagined Mathematics

Magical realism is defined by seamlessly integrating magical elements into everyday reality, where fantastical occurrences are accepted as part of the norm (Bowers, 2020). In the mathematics classroom, this can be paralleled with the often abstract nature of mathematical concepts, which teachers must integrate into students' everyday thinking. Observing lessons through this lens highlights how mathematical ideas, which may initially

appear distant and abstract, become woven into the fabric of students' lived experiences. For example, when students solve complex problems or demonstrate sudden leaps of insight, this can be viewed as akin to the magical moments in a narrative where the impossible becomes possible without disruption to the perceived reality of the classroom. This lens encourages us to see beyond traditional methods of observation, focusing not just on how well teachers impart procedural knowledge or conceptual understanding (Praetorius & Charalambous, 2018), but also on how the classroom becomes a space where multiple realities (mathematical, cultural, and experiential) intersect. This blending of different realities mirrors the integration of magical elements into everyday life in magical realism, allowing for a more holistic understanding of how students and teachers interact with mathematics. By adopting magical realism as a theoretical lens for classroom observation, we open up new ways of understanding the complex realities that shape mathematics teaching and learning. This perspective allows us to move beyond a focus on technical pedagogy and measurable outcomes to explore the deeper, often hidden, dynamics of the classroom. The blending of real and imagined elements, the embrace of ambiguity, and the integration of multiple realities provide a richer framework for analysing how students and teachers interact with mathematical content. Ultimately, this approach offers the potential for more transformative and culturally responsive mathematics instruction, where students' diverse experiences and creative capacities are fully recognised and valued.

In the mathematics classroom, the boundaries between the real and the imagined often blur as abstract concepts intertwine with students' everyday realities (Akkerman & Bakker, 2011). Adopting a magical-realist perspective enables teachers to observe how mathematical ideas, which may initially seem distant or purely theoretical, become embedded in students' lived experiences through problem-solving, storytelling, or culturally relevant examples. Teachers play a crucial role in facilitating this blend by connecting abstract mathematics to familiar contexts, helping students see mathematics not as isolated or obscure, but as part of their personal and social world (Gutiérrez, 2002). Researchers can focus on capturing these moments of conceptual insight and the significance of productive struggle in facilitating deeper learning. This approach challenges traditional methods of observation that prioritise measurable outcomes, promoting a broader and more nuanced appreciation of how students engage with mathematical concepts both cognitively and emotionally.

A Magical-Realist Vignette on Blurring Boundaries (inspired by Sethole, 2004)

In a Year-8 classroom in KwaZulu-Natal, South Africa, Bulelwa begins a mathematics lesson that bridges the abstract with the deeply personal. The topic is number patterns, contextualised within the AIDS epidemic, a subject both profoundly significant and emotionally resonant for her students and their community. Framing AIDS not only as a health crisis but also as a domain for mathematical modelling, Bulelwa introduces her lesson with a worksheet that includes data on population growth and projected increases in AIDS sufferers. Students are analysing trends, describing mathematical relationships, and answering a thought-provoking question: 'What can we do as a society to break the pattern of increasing AIDS sufferers?' This question encourages them to reflect on broader social responsibilities, connecting mathematical analysis to real-world action.

Bulelwa's choice of topic reflects her dual identity as a teacher and a community member deeply affected by the epidemic's impact. In her classroom, mathematics is not a detached subject but a lens through which students explore their lived experiences. Abstract principles become tools for understanding pressing issues, fostering a culturally resonant learning experience that balances technical skill with social and emotional awareness.

As students plot data on their graphs, something extraordinary happens. On one student's line chart, representing the growth of AIDS cases, green vines begin to sprout, curling outward from the paper. The vines twist and grow rapidly, forming branches that stretch across the table, intertwining with neighbouring charts. The class watches in awe as the vines mimic the pattern of disease spread: expansive and uncontrollable.

Bulelwa, unfazed, kneels to examine the phenomenon. 'See how mathematics models life', she says, brushing her hand gently against the swaying vines. 'But unlike this plant, we can shape the outcomes. What would it take to prune these branches?' Her words shift the students' focus, making their questions more urgent. They lean forward, no longer just curious about mathematics but deeply engaged with the choices and actions that influence growth, whether on a graph, in their community, or in their own lives.

Embracing Ambiguity : Productive Struggle in Learning

One of the key features of magical realism is its embrace of ambiguity, where readers are often left uncertain about the boundaries between the real and the magical (Arva, 2008). This ambiguity is similarly present in mathematics education, where students' learning often involves navigating uncertainty and grappling with difficult concepts. Observing a mathematics classroom through a magical-realist lens invites us to appreciate this productive struggle, seeing it not as a barrier to learning but as an essential part of the process. In traditional observation frameworks, maintaining high cognitive demand is emphasised as critical to promoting deep mathematical understanding (Bostic et al., 2021). However, by incorporating the idea of ambiguity from magical realism, we can focus on how moments of confusion, hesitation, and grappling with difficult concepts contribute to transformative learning experiences. Like characters in a magical-realist narrative, students are not provided with clear resolutions but must find their own paths through uncertainty. This struggle, in turn, encourages deeper engagement with the material.

Ambiguity is an inherent part of the learning process, particularly in mathematics, where students often face challenges that require perseverance and deep reflection (Foster, 2011). Through the lens of magical realism, teachers can view this productive struggle as an essential part of learning, where moments of confusion and uncertainty lead to greater understanding. Rather than seeing ambiguity as a hindrance, it can be embraced as a space for students to explore, question, and develop their own pathways to solutions. Researchers can observe how teachers support this process by allowing students to grapple with complex problems, fostering resilience and independent thinking, rather than simplifying tasks prematurely (Milewski et al., 2021). This approach not only encourages deeper engagement with mathematical content but also helps students build confidence in navigating uncertainty. Observing these moments of productive struggle offers a richer understanding of how learning unfolds in non-linear and often unexpected ways, challenging traditional views that equate clarity with progress.

A Magical-Realist Vignette on Embracing Ambiguity (inspired by Foster, 2011)

In a Year-9 mathematics class, a group of six students (Adam, David, Kate, Sarah, Chris, and Ann, aged 14–15) works on calculating the surface area of a solid hemisphere with a radius of 5 cm. They begin by computing

the surface area of a whole sphere and halving it, but their answer does not match the one on the answer sheet. Frustration builds as they suspect the worksheet contains an error. However, their teacher encourages them to rethink their assumptions. This leads to a breakthrough: they realise the hemisphere's base also contributes to the surface area, adding another πr^2 to the total.

This discovery sparks further questions rather than ending the discussion. Adam notes that their initial calculation would have been correct for a hollow hemisphere, prompting the group to explore distinctions between 'hollow' and 'solid' objects. They begin visualising how surface area might differ if they imagine dipping a shape into paint. David suggests that if the inside surface counts, a hollow sphere should have twice the surface area of a solid one. Kate challenges this, arguing that 'insides' are not typically included in surface area because they are hidden. Their debate shifts to volume when David asserts that a hollow and a solid object should have the same volume. Sarah disagrees, pointing out that a hollow hemisphere has no 'real' volume since it would displace no liquid. This rich and productive ambiguity leads the students to question fundamental concepts and form their own definitions, deepening their engagement with the subject.

As the debate grows animated, their sketches fill the board with colourful attempts to clarify the problem. Then, unexpectedly, the solid hemisphere materialises in the centre of the table, glimmering like polished marble. The room falls silent as the object seems to shift subtly with each glance; sometimes appearing hollow, sometimes solid, always ambiguous. Adam reaches out hesitantly, his hand passing through it as though it were made of mist. 'Maybe', he whispers, 'it's both, depending on how we see it'. The teacher smiles, encouraging them to explore further. They circle the object, their ideas becoming bolder, less bound by conventional answers. 'What if maths works this way too?', Kate wonders aloud. 'Not one answer, but lots of truths, all layered together?' The hemisphere flickers, as though responding, before vanishing into the air.

Multiple Realities : Culturally Responsive Mathematics Pedagogy

Magical realism often integrates local myths, folklore, and spiritual beliefs, allowing multiple realities to coexist within the narrative (Danow, 1995). In the mathematics classroom, students bring diverse cultural backgrounds and experiences that influence how they engage with mathematical concepts. Recent examples indicate that children's immigrant

background (Khilji & Xenofontos, 2024) and the gender children identify with (Hafeez & Xenofontos, 2024) have a significant impact on how they choose (not) to participate in the mathematics classroom. Observing lessons through a magical-realist lens encourages us to recognise how these diverse realities shape students' mathematical thinking and problem-solving approaches. This perspective aligns with the growing emphasis on culturally responsive pedagogies, which aim to integrate students' cultural knowledge into the learning process (Marshall et al., 2023; Nolan & Xenofontos, 2023). Viewing the mathematics classroom as a space where different realities coexist allows for a deeper understanding of how teachers create inclusive environments that reflect the diversity of their students' experiences. For example, by linking mathematical problems to real-world contexts that are relevant to students' lives, teachers can make abstract concepts more accessible and meaningful (Aguirre & del Rosario Zavala, 2013). A magical-realist lens, therefore, offers a way to observe not only how well teachers differentiate instruction but also how they validate and incorporate students' unique cultural perspectives into mathematics instruction.

In a diverse mathematics classroom, students bring a range of cultural backgrounds and lived experiences, creating what can be seen as multiple realities. These realities influence how students engage with mathematical concepts and problem-solving. Applying a magical-realist lens enables teachers to observe how students' unique cultural perspectives shape their understanding of abstract ideas, encouraging the integration of culturally responsive pedagogy (Andrews et al., 2005). This approach makes it possible to teach mathematics in ways that are relevant to students' everyday lives, making the subject more accessible and meaningful. Researchers can explore how teachers incorporate students' cultural knowledge into lessons, demonstrating that mathematics is not a purely objective discipline, but one that interacts with personal and cultural narratives (Kelley, 2020). Observing these intersections offers valuable insight into how students' diverse realities are acknowledged and valued, fostering a more inclusive and responsive mathematics education. This perspective encourages a shift from a one-size-fits-all approach, promoting a classroom environment that respects and embraces the richness of students' varied experiences.

A Magical-Realist Vignette on Multiple Realities (inspired by Khilji & Xenofontos, 2024)

In an Oslo mathematics classroom, Amar, Laila, and Maya, three 12-year-old students from immigrant backgrounds, frequently experience a

clash between the mathematical methods they learn at home and those taught in school. Amar, born in Norway to Eastern European parents, often receives help from his father, who introduces him to alternative algorithms and methods. While Amar finds these approaches intriguing, he hesitates to use them in class, unsure if he can explain them to his teacher and classmates in a way they would understand. Laila, whose mother shows her simplified methods for basic arithmetic, enjoys applying her mother's approach when it makes calculations easier. However, in class, she notices her teacher encouraging students to stick to 'the school way', leaving her feeling that her mother's methods are undervalued in an academic context. Despite this, Laila sometimes rebels, saying, 'I use what works for me, even if it's different'.

For Maya, whose family recently migrated from South Asia, the contrast is even more pronounced. At home, Maya's father, who values traditional methods from their home country, teaches her strategies that are unfamiliar in Norwegian schools. Maya views these as private knowledge that bolsters her understanding but keeps them separate from schoolwork, where she adheres strictly to her teacher's methods to avoid confusion. This classroom dynamic reflects a common experience in culturally diverse environments, where students negotiate multiple mathematical identities and methods. School culture subtly pressures them to align with standard practices, creating a cultural distance from their familial methods and experiences. Yet, each student navigates these influences in unique ways, crafting their identities as mathematics learners in a space where multiple cultural realities intersect.

Laila confidently uses her mother's arithmetic shortcut, while Amar begins sketching his father's alternative algorithm beside her. Maya watches, hesitant, aware of the teacher's expectations. As the three students work, the numbers on their papers begin to glow softly, as if highlighting the uniqueness of their methods. But when the teacher approaches, she shakes her head. 'Stick to the school methods', she says firmly. The glow fades, leaving their work dull and lifeless. Amar erases his father's approach with a resigned sigh, replacing it with the school's standard algorithm. Laila hesitates, then sets her work aside, muttering, 'It still works better my way'. Maya does not even begin, tucking her ideas away like a secret she dares not share. The students glance at one another, their shared sense of loss unspoken. The richness of their perspectives remains untapped, and the blending of their ideas never realised. As the lesson continues, the missed opportunity lingers – a faint, shimmering braid of light just visible in the corner of their eyes – something possible, but not permitted.

Disrupting Linear Time : Non-linear Learning in the Classroom

A distinctive feature of magical realism is its disruption of traditional concepts of time and space, where narratives often move fluidly across different periods and realities (Flores, 1955). Similarly, learning in the mathematics classroom does not always follow a linear progression from confusion to mastery. Students may experience moments of sudden insight, regression, or connections across different topics and times. In acknowledging 'the non-linear and non-sequential experiential aspects of working mathematically' (p. 2), Appelbaum (2023) draws on concepts from queer theory, encouraging us to view mathematics learning as a queer practice and to challenge its traditionally taken-for-granted sequential nature. Observing the classroom through a magical-realist lens would involve acknowledging these non-linear learning trajectories, where understanding may develop unexpectedly or in seemingly fragmented ways. This mirrors the observation of instructional quality, where teachers must be responsive to students' varying paths of understanding, adjusting their pedagogical strategies in real time (Doabler et al., 2021). The magical-realist lens emphasises the fluidity of the learning process, allowing observers to appreciate the non-linear and often unpredictable nature of mathematical discovery and insight.

Learning in the mathematics classroom often does not follow a straightforward, linear path. Instead, students may experience moments of sudden insight, regression, or connections between seemingly unrelated topics. Applying a magical-realist perspective allows teachers to appreciate these non-linear learning journeys, where understanding emerges in unexpected ways (Confrey et al., 2014). Observing how students move between different stages of comprehension highlights the fluidity of the learning process, which does not always conform to traditional models of sequential progression. Researchers can examine how teachers respond to these varied learning trajectories, adapting their instruction to support moments of insight while acknowledging the flow of students' understanding (Wilson, et al., 2014). This perspective challenges the conventional emphasis on step-by-step mastery, offering a more dynamic view of how mathematical knowledge develops over time. Embracing the non-linear nature of learning enables both teachers and researchers to gain deeper insight into the complexities of mathematical discovery and the diverse ways students arrive at understanding.

A Magical-Realist Vignette on Disrupting Linear Time (inspired by Marks et al., 2021)

In Ms Liu's classroom, the lesson focused on quadratic functions. The students were divided into small groups, each tasked with discovering patterns in the equations they worked with. Among them, Leo and Sofia sat side by side, approaching the task in contrasting ways. Leo, meticulous and determined, followed the instructions step by step, carefully calculating each variable's role in the equations. Sofia, on the other hand, inspired by a recent lesson on parabolic trajectories, immediately linked the quadratic equations to the arcs of water fountains she'd seen in a park. She began sketching curves, focusing on their shapes rather than precise calculations.

Midway through the lesson, Leo hit an impasse, unable to transition smoothly to the function's vertex form. Frustrated, he glanced at Sofia's sketches. Something about her curves sparked an idea, and he realised that symmetry could be visualised rather than calculated. Suddenly, it clicked; he could identify the function's minimum point simply by observing the parabola's shape. Ms Liu, watching the interaction, gently reminded the class that mathematical understanding does not always follow a strict order; it spirals, overlaps, and occasionally leaps forward in unexpected ways. Leo's insight, born from Sofia's visualisation, underscored the non-linear progression of learning in mathematics. The students continued their work with fresh perspectives, each following their own distinct yet interconnected paths as Ms Liu encouraged them to embrace these unanticipated turns.

As Sofia sketched her fountain-inspired curves, the classroom transformed. Her drawing began to lift from the paper, morphing into a shimmering hologram of arcs and trajectories. The curves stretched and rose, creating an immersive landscape that the students could step into. 'It's like a maze', Sofia whispered, her voice full of wonder. Leo followed her cautiously, running his hands along the glowing parabola. He noticed how symmetry unfolded naturally, not through calculation but through spatial intuition. 'Look!' he exclaimed. 'The vertex is right here!' The hologram shifted as they moved, revealing hidden connections between shapes and equations that had not been visible before. Ms Liu clapped her hands once to bring their attention back. 'Mathematics', she said, 'isn't always a straight path. Sometimes, it's a place you have to wander through before the answers find you'.

An Inconclusive Conclusion

As with the nature of magical realism itself, this exploration of its application to mathematics education does not end with clear-cut answers or definitive outcomes. Rather, it opens new questions and invites us into a space of productive uncertainty regarding the future of teaching and learning. The proposal to view the mathematics classroom through a magical-realist lens encourages educators to embrace ambiguity, imagination, and the blending of multiple realities, offering a fresh perspective on student engagement, pedagogy, and assessment. Nonetheless, for this vision to move beyond theory, empirical grounding is crucial. While this paper primarily establishes a conceptual foundation, the next step involves exploring the practical application of magical realism in mathematics education. Empirical work in this area should focus on interpretive and exploratory methods that capture the richness and complexity of classroom interactions rather than relying on reductive measures or standardised testing. Below, I present some ideas for future explorations.

In-depth case studies conducted in classrooms where teachers adopt magic-realism-informed pedagogies could reveal how abstract mathematical concepts are woven into students' lived experiences. Such studies would focus on observing classroom dynamics, documenting transformative moments, and gathering teacher and student narratives to understand how this framework resonates in practice. Furthermore, ethnographic methods, including participant observation and interviews, would enable researchers to immerse themselves in the day-to-day realities of classrooms using the framework. Attention could be paid to the subtleties of how ambiguity, cultural narratives, and imaginative problem-solving emerge organically in lessons. The goal would not be to quantify outcomes, but to interpret how the framework shapes students' and teachers' experiences. The framework's grounding in storytelling makes narrative inquiry particularly appropriate. Collecting and analysing stories from students and teachers about their experiences with mathematics could offer insights into how magical realism transforms their perceptions of learning and engagement. These stories would highlight the interplay of abstract and lived realities without requiring standardised metrics. Engaging teachers as co-researchers in action research projects could enable a collaborative exploration of the framework's impact. Together, researchers and practitioners could design and trial lessons, iteratively reflecting on their effectiveness in blending imaginative,

cultural, and mathematical elements. This iterative process would privilege insight and adaptation over fixed outcomes.

Professional development programmes could invite teachers to experiment with the ideas of magical realism in their classrooms. Reflective practices such as journals, discussion groups, and collaborative lesson planning would allow educators to explore how they engage with the framework. Researchers could gather these reflections to examine the pedagogical shifts and challenges experienced by teachers. Likewise, initial teacher education programmes could provide opportunities for prospective teachers to engage in activities that connect abstract mathematical concepts with students' lived experiences. These activities might include classroom observations (through school placements or recorded lessons), simulations, and discussions, enabling future teachers to explore culturally responsive teaching, innovative pedagogical approaches, and non-linear learning trajectories. Reflective practices stemming from these experiences could help prospective teachers creatively apply elements of this framework in their future classrooms.

Even though this paper has focused on magical realism as a lens for reimagining mathematics education, it should be acknowledged that this is not the only possible alternative. Afrofuturism, for instance, offers an alternative framework that warrants attention. Afrofuturism, rooted in the cultural imagination of the African diaspora, envisions liberatory futures by blending historical, present, and futuristic narratives in ways that disrupt linear conceptions of time (Yaszek, 2006). Drawing on Appelbaum's (2010) concept of 'retrodictive curriculum', which involves imagining a transformative future and working backwards to trace the pathways that could lead to it, Afrofuturism could provide a powerful method for rethinking pedagogy. This approach complements the non-linear and imaginative aspects of magical realism, broadening the discussion on how pedagogy can honour diverse cultural narratives while cultivating creative and reflective learning. Future research could explore how these frameworks intersect to transform the mathematics classroom into a space for dynamic and inclusive exploration.

While the magical-realist framework challenges traditional approaches to mathematics education, its potential to unlock creativity and support non-linear, transformative learning is immense. Embracing ambiguity and integrating multiple realities into the classroom enables teachers to create more inclusive, engaging, and intellectually stimulating learning environments. The magical-realist classroom, with its fluid boundaries and

complex realities, does not seek to deliver quick solutions or measurable outcomes, but rather nurtures a deeper engagement with the ongoing, often non-linear learning process. Ultimately, the journey towards reimagining mathematics education through magical realism is just beginning. Its success relies on continued collaboration between teachers, teacher educators, researchers, and policymakers, who must be open to experimenting with and refining these ideas in practice. The invitation is clear: it is time to blend the real and the imagined, the concrete and the abstract, and to build a mathematics classroom that embraces the richness and complexity of both worlds.

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