Challenging One-Size-Fits-All Contexts: Primary Teachers Experiencing Culturally Responsive Mathematics Teaching as Learners

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Contextualisation is expected to bridge school mathematics with real life, yet classroom contexts are often treated as universal, assuming that one context can fit all learners. Culturally Responsive Pedagogy (CRP) challenges this assumption by positioning students' cultural and lived experiences as central resources. This paper examines how Indonesian primary teachers, engaged as learners in a culturally responsive mathematics professional development (PD) workshop on whole numbers and place value, came to reframe mathematical meaning as culturally situated rather than universal.

Contextualisation is widely suggested as a means of making school mathematics meaningful and relevant (Boaler, 1993; Palm, 2008). Yet many students are continuing to struggle to connect school mathematics with their lived experiences (Civil, 2016). A persistent problem lies in how contexts are selected: classroom tasks frequently draw on situations assumed to be universally familiar, yet what counts as "everyday" is itself culturally situated. When instructional contexts privilege particular social groups while rendering others' experiences invisible, contextualisation can inadvertently deepen rather than bridge cultural disconnects (Sullivan et al., 2003; Nasir et al., 2008). De Lange (1995) distinguishes between *relevant and essential contexts*, which actively support mathematisation by requiring genuine reasoning, and *camouflage contexts*, which dress tasks in superficial narratives while eliminating the cognitive demand that authentic contextualisation is meant to produce. The overuse of camouflage contexts, particularly those drawn from culturally narrow or socioeconomically exclusive situations, limits opportunities for meaningful mathematical learning (Boaler, 1993).

Nasir et al. (2008) distinguish two levels of context in mathematics classrooms: the *task context* - the real or imagined setting framing a mathematical problem, and the *pedagogical context* - the broader learning environment shaping how students participate and whose knowledge is valued. One-size-fits-all approaches typically operate at the level of task context, deploying standardised situations assumed to be meaningful across diverse learners. This is illustrated in Indonesian mathematics textbooks, where problems situated in swimming extracurricular activities (Fitrianawati et al., 2022) may reflect experiences that are more accessible to students from higher socioeconomic backgrounds. Such contexts can transmit implicit messages about whose experiences are valued in school, giving advantages to students whose home culture aligns more closely with school culture, not because of inherent ability, but because of cultural familiarity. This study is concerned specifically with the *pedagogical context* of professional development (PD). Although effective mathematics PD is characterised by content focus, active learning, coherence, sustained duration, and collective participation (Desimone, 2009), PD programmes often treat pedagogical context as a delivery channel for techniques rather than as a cultural learning environment for its participants. When PD itself operates within universalised pedagogical context, teachers' tacit assumptions about whose mathematics counts and whose contexts matter remain unexamined. This study therefore foregrounds how the design of PD as a cultural learning environment shapes what teachers come to understand about mathematics, context, and their students.

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Culturally Responsive Mathematics Teaching (CRMT) addresses the problem of pedagogically universalised contexts by centring students' cultural identities and funds of knowledge as foundations for mathematical learning (Aguirre & Zavala, 2013). When the same task contexts are deployed across all classrooms, students whose lived experiences fall outside those contexts may disengage or participate only superficially, while students whose home cultures align with the chosen contexts gain unearned advantages (Boaler, 1993; Sullivan et al., 2003). Grounded in sociocultural theory (Vygotsky, 1978), CRMT recognises that mathematical meaning is neither culturally neutral nor universal, but is shaped by linguistic practices, representational systems, and social contexts. CRMT is not limited to classrooms serving specific minority groups; its principles enhance learning for all students by fostering relevance, engagement, and belonging in diverse educational settings (Aronson & Laughter, 2016). In mathematics, CRMT connects learning to students' lived experiences, affirms diverse problem-solving approaches, and employs mathematics as a tool for reasoning about social justice (Gutstein et al., 1997; Aguirre & Zavala, 2013). Viewed through a CRMT lens, the problem of universal contexts is reframed: rather than seeking a single context that works for everyone, teachers come to recognise that any context is perceived differently across learners, and that this diversity is the resource through which mathematical meaning is constructed.

Yet transforming teaching towards CRMT requires more than professional awareness. Teachers' understandings of mathematics and context are deeply shaped by their own schooling within culturally neutral or universalised systems. Meaningful teacher learning must surface and reconstruct these assumptions through experience rather than transmission alone (Ball et al., 2008). Prior research has documented how teacher identity and positionality shape beliefs about equity and participation in mathematics (Bonner & Adams, 2012; Gutstein et al., 1997). However, fewer studies examine what teachers learn when they engage *as learners* in CRMT environments, rather than merely reflecting on CRMT principles as observers (Abdulrahim & Orosco, 2020; Gutiérrez, 2007). Guided by Vygotsky's (1978) view that knowledge is constructed through participation in meaningful social practice, this study positioned teachers as mathematics learners within a CRMT-focused PD programme. The programme comprised five sequential workshops moving teachers from cultural engagement with mathematics (Workshops 1–2), through explicit study of CRMT principles (Workshop 3), to designing their own CRMT lessons (Workshops 4–5). This paper focuses on Workshop 2, in which teachers engaged as learners with whole numbers and place value, because it offered the clearest evidence of how mathematical meaning is constructed when teachers themselves occupy the learner position within a CRMT environment. The study is guided by the research question: "How does engaging as learners in a CRMT-focused professional development reshape primary teachers' understanding of mathematical context and meaning in concept of whole numbers and place value?"

Background Literature

Professional Development in Culturally Responsive Mathematics Teaching

Teachers' understandings of mathematics, learning, and context are deeply shaped by their own experiences as students within traditional, often culturally neutral or universalised mathematics systems (Ball, 1988; Mewborn & Tyminski, 2006). Shifting these assumptions becomes a central task of PD for mathematics teachers. In general, effective mathematics teacher PD is generally characterised by content focus, active learning opportunities, coherence with teachers' existing knowledge and policy contexts, sufficient duration, and collective participation (Desimone, 2009). Yet syntheses of CRMT-oriented PD show that even well-designed programmes frequently leave teachers' underlying assumptions about what counts as mathematics and whose contexts matter unexamined, focusing instead on awareness of cultural

diversity or surface-level adaptation of curriculum materials (Abdulrahim & Orosco, 2020; Aguirre & Zavala, 2013; Gutiérrez, 2007). Meaningful teacher learning therefore requires opportunities to surface, question, and reconstruct these assumptions through experience rather than transmission (Ball et al., 2008). Drawing on Vygotsky's (1978) account of learning as participation in social practice, this study takes the position that teachers learn most powerfully about CRMT not by being told its principles, but by participating in mathematics learning environments designed around them, encountering the norms, expectations, and cultural messages of CRMT first-hand.

Culturally Responsive Mathematics Teaching (CRMT)

Culturally Responsive Mathematics Teaching (CRMT) is grounded in sociocultural theory, which asserts that cognitive development is mediated through sociocultural practices and the use of culturally constructed tools and symbols (Vygotsky, 1978). CRMT addresses the lack of cultural relevance in mathematics education by drawing on Culturally Responsive Pedagogy (CRP), articulated by Ladson-Billings (1995) and Gay (2018), which rests on three fundamental pillars: (1) a commitment to academic success; (2) a commitment to cultural competence; and (3) the empowerment of students' critical socio-political consciousness. In the mathematics classroom, Gutstein et al. (1997) specify these commitments by connecting mathematics to social justice, respecting diverse methods of problem-solving, using culturally relevant contexts, and treating mathematics itself as a tool for social-justice reasoning.

Methodology

Participants and Professional Development Design

The study draws on data from a CRMT-focused PD programme involving 25 upper primary teachers (Grades 4–6) from 12 public primary schools in Indonesia. Participants held varied teaching experience, with the majority having more than five years of classroom practice and primary education qualifications. The PD comprised five workshops, each lasting approximately 5–6 hours, facilitated by two mathematics educators experienced in CRMT research and curriculum design. PD design drew on the CRMT lesson analysis framework articulated by Aguirre and Zavala (2013) and principles from Ellis et al. (2019), emphasising high cognitive demand, affirmation of diverse mathematical identities, use of students' linguistic and experiential resources, and connections to social justice. Workshop 1 introduced relationships between mathematics and culture; Workshop 2 positioned teachers as learners in a CRMT lesson on whole numbers and place value; Workshop 3 examined CRMT principles directly; and Workshops 4–5 focused on designing CRMT lessons.

This paper concentrates on Workshop 2, in which teachers engaged with whole numbers and place value. While shifts in teachers' thinking were observed across all five workshops, the illustrative evidence presented here is drawn specifically from Workshop 2. Two task types were used: a personal name-tag activity anchoring number meaning in participants' own lived experiences, and a grouping-and-packaging task designed to surface the conceptual foundations of place value. Facilitators used participants' informal language and task artefacts as instructional resources throughout, introducing formal mathematical terminology only after conceptual engagement with concrete and pictorial representations.

Data Sources and Analysis

Data sources for this paper were selected to address the research question by capturing both teachers' in-the-moment engagement and their retrospective sense-making of that engagement. They include teachers' written reflections (completed individually at the end of Workshop 2), completed task artefacts (name tags and grouping worksheets), and facilitator field notes. Written reflections responded to three structured prompts asking teachers to describe what they

noticed, what surprised them, and how their thinking about mathematics teaching may have shifted, each prompt directly soliciting evidence of conceptual reshaping. Task artefacts provided a record of teachers' mathematical activity as learners, while field notes documented facilitator observations of group discussion and conceptual shifts. Qualitative thematic analysis (Braun & Clarke, 2006) was conducted across these sources to identify patterns in how teachers reframed mathematical context and meaning through the workshop experience.

Findings

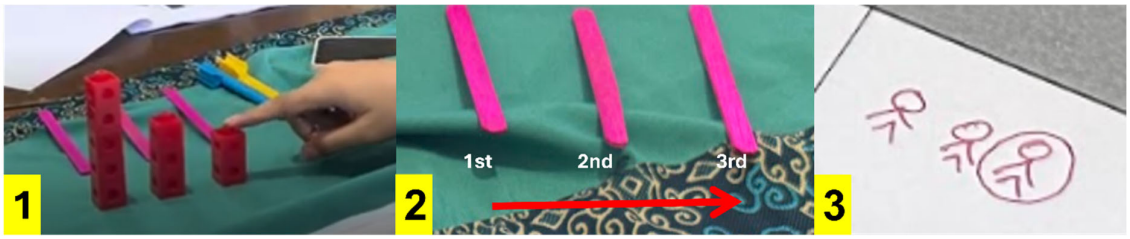
Theme 1: Reframing Mathematical Meaning Through Language and Lived Experience

A key shift during Workshop 2 was teachers' reconceptualisation of mathematical meaning as grounded in their own language and lived experience, rather than in universalised contextual examples and abstract definitions. Activities on whole-number meaning began with teachers constructing personal name tags: their nickname at the centre, surrounded by four personally chosen numbers at the corners, each carrying a different story. These artefacts became instructional resources for distinguishing cardinality (numbers representing quantity) from ordinality (numbers representing position), anchored in participants' own experiences. The personal name-tag task made visible the diverse meanings numbers carry across different lives and contexts, directly challenging the assumption that number concepts are experienced uniformly.

As teachers discussed their chosen numbers in groups, they came to know one another through these personal number stories, and a recurring conceptual confusion emerged. When asked to represent "the third" using concrete manipulatives, most groups initially constructed a podium arrangement—three objects in descending height (Figure 1, left), rather than identifying a single object in a sequence. This response reveals a common conflation of ordinal and cardinal meaning: treating ordinality as a property of a collection rather than as a property of a position within it.

Figure 2

Conceptual shift in the ordinal meaning of whole numbers: from a podium-based ranking (1), to a reference-point model in which the number names a position in a sequence relative to a starting point (2), to using that ordinal position to identify which specific object is being referred to (3).

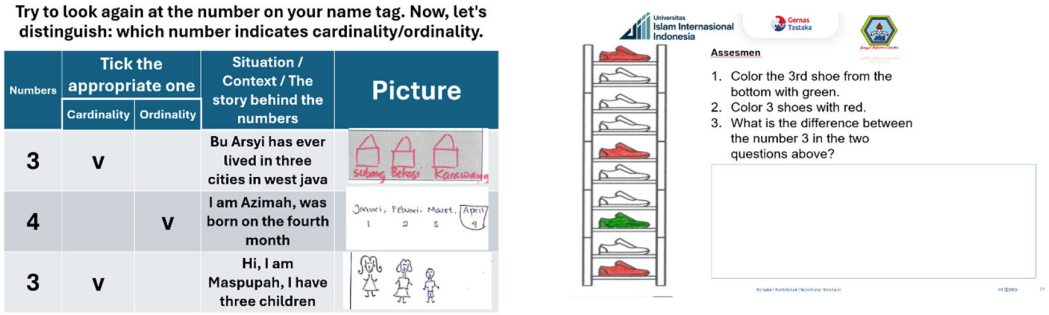


The facilitator followed up with the question, "Which one is the third?", and offered an everyday illustration: a mother whose three children all come home together, contrasted with a mother who calls only her third child, with that single child coming alone. This contrast prompted a visible conceptual shift across most groups: in the podium arrangement, the number three referred to a cardinal collection of objects, whereas in the mother-and-children scenario, three identified the ordinal position of a specific child relative to a starting point. Facilitator field notes recorded that this moment generated extended discussion across all six groups, with teachers recognising that, in showing ordinality, the number of objects does not directly represent the ordinality itself; the reference point from which the sequence is counted is equally important. The shift from conflation to differentiation was confirmed through the colouring assessment task and a categorisation task on cardinal and ordinal meanings of numbers, drawing

on each group member's personal story (see Figure 2), in which the majority of teachers correctly applied both cardinal and ordinal interpretations.

Figure 3

Task on Differentiating the Meaning of Whole Numbers (Cardinality/Ordinality) using their own personal story (left) and a Colouring Activity (Right).



Try to look again at the number on your name tag. Now, let's distinguish: which number indicates cardinality/ordinality.

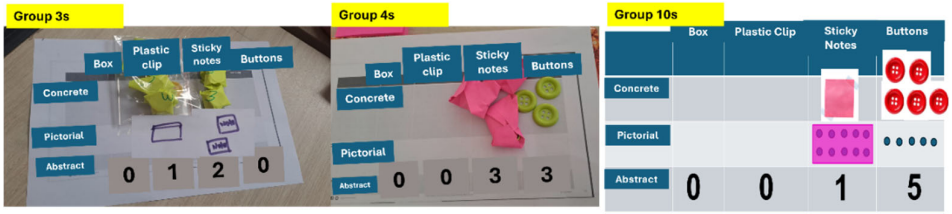
Numbers	Tick the appropriate one		Situation / Context / The story behind the numbers	Picture
	Cardinality	Ordinality		
3	v		Bu Arsyi has ever lived in three cities in west java	
4		v	I am Azimah, was born on the fourth month	
3	v		Hi, I am Maspupah, I have three children	

Written reflections reinforced this reorientation toward language as a resource. One participant wrote: "I used to think students had to learn the correct mathematical terms first. Now I realise their everyday stories are actually the doorway to understanding the concept." Another noted: "When I worked with the objects first, the symbols finally made sense. It reminded me how students might feel." These responses, evident across more than two-thirds of the written reflections, indicate a substantive shift away from the assumption that formal mathematical language must precede or replace informal expression. Rather than treating everyday language as something to be corrected, participants increasingly recognised it as a legitimate and productive entry point into conceptual understanding. This reorientation repositioned students' linguistic and cultural resources, often treated as deficits in traditional mathematics instruction, as pedagogical assets central to CRMT. In doing so, it directly challenged the one-size-fits-all assumption that mathematical meaning must be transmitted through a single "correct" linguistic or contextual frame: when teachers' own everyday words and lived stories produced legitimate mathematics, the necessity of a uniform context for all learners dissolved.

Another line of evidence showed how CRMT experiences enabled teachers to see place value as the transformation of informal language into the formal language of mathematics. The place-value activity used a packaging-and-grouping task: teachers chose their own grouping base (e.g., groups of 3, 4, or 10) and applied it consistently to a set of concrete objects, developing informal language to describe their groupings before formal mathematical terminology was introduced. Figure 3 shows sample teacher artefacts from this activity, illustrating how different grouping decisions produce visually and linguistically distinct representations of the same quantity.

Figure 4

Sample teacher artefacts from the Grouping and Packaging Activity on place value using fifteen buttons. Informal linguistic representations show: 1 plastic, 2 sticky notes, and 0 buttons (grouping by 3s); 3 sticky notes and 3 buttons (grouping by 4s); and 1 sticky note and 5 buttons (grouping by 10s)



Facilitator field notes recorded that most groups initially struggled to articulate why this activity was necessary, but through the activity came to see the ones/tens/hundreds structure as

the result of agreed-upon grouping decisions rather than an intrinsic property of numbers. Task artefacts showed teachers using informal language, describing groups as "homes" or "containers" for objects, as a conceptual bridge to formal place-value terminology. Written reflections showed this framing to be generative: one participant wrote, "I always taught place value as tens and hundreds because that is what the book says. I never questioned why it works that way." Another noted that the activity helped her understand "where the words actually come from," rather than accepting formal terms as given. Facilitator field notes also documented that teachers who chose non-standard grouping bases (e.g., base 3 or base 4) found the subsequent introduction of base-ten more meaningful, precisely because they had experienced the *choice* that underpins any grouping system. Because each group could choose its own container and grouping rule, comparison of artefacts across groups also made the relational nature of place value visible: the digit "1" in a base-3 grouping does not represent the same quantity as the digit "1" in a base-10 grouping. Through this contrast, teachers experienced place value as a system whose meaning depends on agreed-upon contextual conventions rather than as a single fixed structure, again undermining the one-size-fits-all framing.

Theme 2: Experiencing Mathematics as a Tool for Social Justice

The second theme captures how teachers experienced mathematics as a means for reasoning about social justice, rather than as a set of skills applied to neutral or superficial contexts in word problems. This theme bears directly on the research question: by foregrounding contexts in which whose lives, whose access, and whose fairness were explicitly at stake, the workshop offered an alternative to one-size-fits-all contextualisation. Rather than situating mathematics within a generic "real-world" setting, tasks were grounded in contexts that named the cultural and social specifics of the people they concerned. One task is set to Eid Al-Adha celebration when neighbourhood committees typically distribute qurban meat coupons to local families: students were asked to analyse how a community leader's transcription errors, recording 210 as 21 for RW 03 and 160 as 106 for RW 04, would affect the just distribution of meat between the two neighbourhoods. The task invited teachers to use place-value concepts to analyse and respond to an unequal distribution scenario drawn from a realistic social context.

Several participants reported that this was their first experience using foundational mathematics concepts to reason about social justice. Written reflections showed that many teachers initially approached these tasks as standard word problems, focusing on calculation strategies, before recognising the embedded social justice context and shifting to questions of fairness. One teacher wrote: "I thought social justice was only for older students. I didn't realise basic number concepts could help children think about fairness." Another reflected: "I started solving the numbers and then stopped. I realised the question wasn't asking me to just calculate, it was asking me to decide what was fair." Facilitator field notes recorded that reflection prompts asking teachers to consider whose perspectives were represented in the mathematical problems generated the most extended discussions of the workshop, with participants drawing connections to their own students' diverse socioeconomic backgrounds.

Discussion and Conclusion

This study contributes to CRMT professional development research by demonstrating how positioning teachers as learners within CRMT-designed mathematical environments makes the cultural dimensions of mathematical meaning visible and experientially grounded. Prior syntheses note that CRMT-oriented PD often addresses culture at the level of awareness, reflection, or curriculum context without showing how culture operates within mathematical meaning-making itself (Abdulrahim & Orosco, 2020; Gutiérrez, 2007), leaving teachers to value cultural responsiveness in principle while continuing to experience mathematics content as culturally neutral and procedurally fixed. The findings respond to this gap by showing that

experiential engagement—encountering culture through mathematical activity rather than as a separate topic—shifts how teachers make sense of mathematical concepts, with contextual diversity functioning as a resource that supports rather than complicates sense-making.

The central contribution of the first theme is that engaging teachers as learners in CRMT-designed mathematical tasks restructures their understanding of mathematical meaning itself. Teachers experienced linguistic and cultural resources as constitutive of mathematical content rather than backdrop, consistent with Vygotsky's (1978) account of language as a primary mediating tool for thought. Across both activities, teachers moved from accepting formal mathematical language as given to recognising it as emerging from lived cultural experience—a trajectory mirroring the informal-to-formal progression. The packaging-and-grouping task illustrated this most clearly: by constructing their own grouping systems and informal terminology before encountering base-ten, teachers experienced the cultural contingency of place value as a felt insight rather than an abstract claim. This experiential basis is consistent with Prediger and Wessel's (2013) intervention evidence that scaffolding from informal to formal registers produces significantly stronger conceptual gains than mathematics-only instruction. The present findings extend this evidence from learners to teachers-as-learners, addressing long-standing assumptions about mathematics as neutral and universal (Bishop, 1988).

The second theme demonstrates that foundational number concepts can serve as substantive vehicles for social justice reasoning from the early primary grades. This extends Gutstein's (2003) demonstration of mathematics as a tool for "reading and writing the world" into the under-researched terrain of foundational arithmetic, where the connection between place-value reasoning and distributive justice is rarely made explicit. That many teachers described the social-justice framing as genuinely new, and reported that it transformed their engagement with the mathematical task itself, resonates with Bartell's (2013) finding that teachers learning to teach mathematics for social justice must continually negotiate between mathematical and social-justice goals. The Eid Al-Adha task made this visible: a transcription error of 210 as 21 was no longer a careless slip but a misrepresentation affecting whose family received qurban meat, so place value became a representational system whose accuracy carries fairness weight. In direct relation to the research question, this indicates that the contextual diversity foregrounded by CRMT—whose lives, whose fairness, whose mathematics—is not an extension added after content learning, but a vehicle through which content learning is itself constructed (Gutstein et al., 1997).

This study demonstrates the potential of experience-based professional learning to support CRMT. When teachers engage as learners in CRMT-focused PD, encountering whole numbers and place value through their own languages and lived experiences, they are better positioned to challenge one-size-fits-all contextualisation and to envision mathematics as a site for equity and social justice. Future studies should examine how these shifts are enacted and sustained in the classroom.

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