Journal of Education, Learning, and Management (JELM)

ISSN: 3079-2541 (Online)

Volume 2 Issue 2, (2025)

https://doi.org/10.69739/jelm.v2i2.1241

https://journals.stecab.com/jelm

Published by
Stecab Publishing

Research Article

A Literature Review of Multicultural Approaches in Mathematics Education: Integrating Culture, Equity, and Pedagogical Practices

*[1]Shella Fanoga

About Article

Article History

Submission: November 03, 2025
Acceptance : December 07, 2025
Publication : December 15, 2025

Keywords

Culturally Responsive Pedagogy, Equity in Education, Ethnomathematics, Multicultural Mathematics Education, Social Justice in Education, Teacher Preparation

About Author

[1] National Aviation Academy of the Philippines

Contact @ Shella Fanoga
wasweet91@gmail.com

ABSTRACT

This literature review examines how pedagogy, equity, and culture interact to influence student learning in multicultural mathematics education. It demonstrates the importance of grounding mathematics classrooms in the cultural identities, community practice, and lived experiences of learners from an array of sociocultural, critical, and ethnomathematics perspectives. The review is organized around a set of key themes, such as systemic inequities, culturally responsive pedagogy, ethnomathematics and local knowledge, inquiry-based and multilanguage instruction, assessment methodologies, teacher development, technology, and the sociopolitical environments in which teaching and learning occur, and reflects upon progress made as well as remaining challenges. While progress has been documented, significant challenges remain, particularly in teacher training, equitable assessment, and institutional support. In this review, 43 peer-reviewed studies, published from 2010 to 2024, are synthesized across various cultural and educational contexts, thus giving a broad overview of multicultural methods in mathematics teaching. Future work should focus on multilingual learning and technology-rich classrooms, justice-oriented policy frameworks, and the integration of indigenous and community-based systems of knowledge. Overall, the review emphasizes the idea that a multicultural, and culturally sustaining, orientation to mathematics education provides the potential for mathematics teaching and learning that is more inclusive, equitable, and transformative for all students.

Citation Style:

Fanoga, S. (2025). A Literature Review of Multicultural Approaches in Mathematics Education: Integrating Culture, Equity, and Pedagogical Practices. *Journal of Education, Learning, and Management, 2*(2), 406-415. https://doi.org/10.69739/jelm.v2i2.1241

1. INTRODUCTION

Multicultural and culturally specific pedagogies in mathematics education aim to change how teachers teach and what they choose to teach to match the cultures and real-world experiences of all students. The main idea of multicultural-specific pedagogy in mathematics education is the idea of persuading somebody to teach mathematics in ways relevant to students' cultural identities, specifically for students who are part of a minority and/or marginalized identity. This pedagogy is based on conceptual and curricular resources that are meant to resist and challenge forms of oppression that students encounter in educational math contexts today (Acharya *et al.*, 2021; Leonard, 2018; Rosa & Orey, 2016).

Understanding the connection of culture and thinking with the learning needs of minority student groups is central to understanding how math education can be both equitable and empowering. In sociocultural ways of thinking, culture is a part of students' thinking, and how they think about ideas in mathematics. Teachers who align their instruction with students' culture and ways of thinking could potentially improve the relevance and effectiveness of their lessons by meeting the actual aims and needs of minority groups to learn (Leonard, 2018; Nortvedt & Buchholtz, 2018; Robertson & Graven, 2019). It is important to understand the difference between teachers responding to students' culture (CRT) and using culture to help students learn (CRP). Both of these practices are attempting to use students' culture in an effective way.

But they differ in some ways. Culturally responsive teaching is about knowing students' culture and using it to make more personal, better lessons; creating real connections to what is being taught and a real desire to learn (Harding-DeKam, 2014). Culturally relevant teaching, on the other hand, is often seen as helping students fight injustice and unfairness in the world by giving them the tools to see and act on them. It says that teachers should just think about students' culture, but should also use it for a real purpose. That purpose is to help students do better in school, to help them relate to other cultures, and to see what's wrong with the world around them (Hamdan Alghamdi, 2014; Neri *et al.*, 2019; Tanase, 2021). These ways of thinking about teaching shape how teachers see multicultural teaching in math.

In order to define the limits of this review, the following inquiries are posed as a framework for the analysis: (1) What influence do multicultural, culturally responsive, and culturally relevant pedagogies have on the teaching and learning of mathematics in diverse cultural and linguistic contexts? (2) What equity-related issues like language barriers, assessment methods, institutional constraints, and teacher readiness hinder the implementation of multicultural mathematics education? (3) Which teaching strategies, among others, such as ethnomathematics, translanguaging, inquiry-based learning, and technology integration, are effective in promoting and ensuring culturally inclusive and equitable mathematics instruction? and (4) In what ways do societal and political as well as justice viewpoints shape the goals and results of multicultural mathematics education?

2. LITERATURE REVIEW

2. 1. Historical and theoretical foundations

The theoretical and historical foundations of multiculturalism, as they apply to mathematics education, are pretty much based on the sociocultural perspective, which posits that cognitive development and learning are inherently situated in cultural and social contexts. Sociocultural theory serves as the foundation of multicultural pedagogy, in that it specifies that learning is not simply an independent cognitive operation, but rather it is mediated by cultural tools, language, and social interaction. This perspective highlights the importance of culturally relevant teaching within the lived and learning contexts of students (Leonard, 2018; Ndemanu & Jordan, 2017; Robertson & Graven, 2019).

Ethnomathematics has emerged as a relevant model for multicultural mathematics education. Ethnomathematics provides a theoretical foundation and its own practices and methods for connecting mathematics concepts and skills to cultural and community practices across different communities; and epitomizes the value of mathematical knowledge systems that exist within a given community's indigenous, professional, and generational perspectives, and facilitates the emphasis of the experiences, knowledges, and practices of learners (Ng'asike, 2014; Rosa & Orey, 2016; Zidny *et al.*, 2020).

A study and enactment of multicultural education will rest on theoretical placements, such as postcolonial theory, Vygotskian theory, and critical pedagogy. For instance, Vygotskian theory (associated with sociocultural cognition) provides a basis for understanding how learning occurs through social interaction and cultural mediation. Understanding these phenomena is important in considering some of the practices described for enacting multicultural pedagogy (Sotero *et al.*, 2020; Jurado de los Santos *et al.*, 2020). Postcolonial theory critiques the ongoing impacts of colonialism, in educational content or institutional structures or both, and considers the possibility that curricula and practices serve as instruments of cultural hegemony (Neri *et al.*, 2019); critical pedagogy examines how education can be utilized to help students also question oppression and social inequalities and connect their learning in the classroom to the struggle for social justice more broadly (Brown, 2017). Each of these, in tandem with other theoretical frameworks, stimulate an approach to education that deliberately promotes equity and values the communities, knowledge, and experiences from marginalized identities.

2.2. Importance of integrating culture in mathematics education

It is important to teach mathematics with culture so that the learning becomes authentic for a diverse group of students (Leonard, 2018; Robertson & Graven, 2019). When students are able to connect mathematical content, and their culture, and way of thinking, the learning process will become more engaging. According to Harding-DeKam (2014), knowledge of their students' home and community lives helps elementary classroom teachers teach and have their students understand and engage in mathematics. This method challenges the old way of teaching which excludes kids from different backgrounds.

We should see cultural diversity in education as something to celebrate and learn from, not as a problem to solve. Schools in different urban settings, for example, have increasingly called for teaching models that connect the cultural gap between predominantly middle-class, monolingual European ancestry teachers and their culturally and linguistically diverse students (Ndemanu & Jordan 2017; Neri *et al.* 2019; OECD 2019). Teachers can improve their math lessons by using their students' backgrounds and culture. Therefore, they can make the lessons more impactful.

In addition, accepting and including the community and home cultures of students increases student motivation and enhances their learning experiences. This enables teachers to incorporate mathematical practices that are culturally embedded, local knowledge and problem contexts that are culturally meaningful, which enriches the learning experience and relates with students' realities (Ng'asike, 2014; Tanase, 2021; Zidny *et al.*, 2020).

2.3. Equity in mathematics education: definitions and challenges

2.3.1. Conceptualizing equity in education

The concept of "equity in education" is interpreted differently across political, cultural, and social contexts because of its complexity. How it is defined and implemented is heavily shaped by the political and sociocultural conditions of each educational system (Jurado de los Santos *et al.*, 2020). Equity is typically regarded as fairness and justice in education, although the ways it is enacted are often different.

Intersectionality is important to equity. Earning one's place in race, class, gender, language and other identifiers point to the experiences and outcomes of students in education. They are usually interwoven and mutually influencing. Multiculturalism recognizes layers and attempts to alleviate disparities due to institutionalized prejudice (Leonard, 2018). In cases like that of Nepal, considerations for equity also pertain to language justice, ethnicity, gender and socioeconomic status in addition can make the provision of equitable mathematics education more complex (Acharya *et al.*, 2021).

A central issue in equity discussions is the gap between simply providing equal access and pursuing education grounded in justice. While equality of access is interested in providing all students with the same opportunities and resources, equity that is oriented towards justice also calls for adjustment to the structures, which focus on power imbalances as well as injustices in the past (Jurado de los Santos *et al.*, 2020; Zilliacus *et al.*, 2017). Curriculum innovation in countries like Finland is the best example of this commitment, where inclusivity, equity, and respecting diversity are given emphasis across the curriculum, though it might be challenging to implement such policies in reality (Zilliacus *et al.*, 2017).

2.3.2. Equity gaps in mathematics learning outcomes

There are also mathematics achievement gaps that occur in relation to gender, race, and socioeconomic status despite policy attempts (Jurado de los Santos *et al.*, 2020; Zilliacus *et al.*, 2017). Research also indicates widespread performance disparities across majority and minority students, and for some, gender differences (Nortvedt & Buchholtz, 2018). These disparities in performance are linked not only to individual ability, but structural conditions including access to top-notch instruction, culturally-responsive pedagogy, and other resources (Leonard, 2018, Hamdan Alghamdi, 2014).

Language can be an important obstacle for students in mathematics education. Students are often in learning settings where language is an explicit barrier in mathematics education. Students who learn mathematics in a language that's not their first language may struggle to maintain their understandings of mathematical concepts and meaningfully engage in problem-solving activities. For example, a common concern in South Africa is the high use of English as the medium of instruction, which may have a detrimental effect for the home language speakers, whose home language differs from English, or for those students with less proficiency in English. This may without a doubt limit a student's engagement and achievement in mathematics (Robertson & Graven, 2019). It is clear that language barrier influences student performance in mathematics education in national and international assessment contexts.

Economic and social factors complicate the inequalities already present in mathematics attainment. Students coming from poorer backgrounds generally do not have the resources or supports for their full participation and success in mathematics (OECD, 2019; Nketsia *et al.*, 2020). The rise of considerable educational inequalities that were exacerbated by the COVID-19 pandemic has heightened the burden of inequality faced by low-income households, and the combination of remote learning and lack of access to technology has become particularly worrisome regarding educational inequalities (Yılmaz *et al.*, 2021). Collectively, these experiences place an even greater urgency on sound, varied, and practical ways to facilitate equitable experiences for all students to learn.

2.3.3. Policy and institutional barriers to equity

Barriers to creating and implementing policies frequently complicate equity-focused mathematics education (Brown *et al.*, 2021). Regarding assessment policy in particular, it is challenging to measure student mathematical ability accurately and equitably across different groups of students because of technical difficulties and political aspects (Nortvedt & Buchholtz, 2018). The relationship between policy and classroom practice prioritizes policy interests in classroom practice; although policy mediates classroom practices, classroom practices also reveal areas needing policy change (Nortvedt *et al.*, 2020).

Institutional resistance to culturally relevant education can occur in many forms (e.g., teachers are not sure, schools do not act quickly enough). This resistance is often due to what we do not know, apprehension of effectiveness, and lack of experience, all of which can lead to inconsistent and haphazard implementation of culturally relevant pedagogy (Neri *et al.*, 2019). Acknowledging resistance in the multi-layered and context-specific challenges makes it possible to have focused interventions and professional development that provide support for more effective implementation of culturally relevant practices.

Preparedness of teachers and knowledge of diversity shape equity outcomes in important ways. In a range of contexts, teachers do not have enough knowledge or strategies to support

linguistic and/or cultural diversity. Data from Finland shows that even with decades of experience, teachers do not have the knowledge or training to provide an adequate response to the diverse learning needs of their students, reiterating the need for better and enhanced pre-service and in-service teacher education (Acquah *et al.*, 2015; Nketsia *et al.*, 2020). Addressing teacher knowledge and practice is especially important for equitable practices to become part of classroom instruction.

2.4. Culturally responsive teaching strategies

Culturally responsive teaching (CRT) in mathematics entails deliberately weaving students' cultural backgrounds, interests, and everyday experiences into both lesson planning and classroom practices (Harding-DeKam, 2014; Tanase, 2021). When utilized purposefully, CRT links mathematics to 'real-world' contexts that are salient to students, thus encouraging their participation in mathematics and allowing for a deeper understanding of what is being taught (Tanase, 2021).

Teachers can also develop lessons that have origins in students' cultural practices that address oppression and inequity and use mathematics to promote social justice and student empowerment (Leonard, 2018; Ndemanu & Jordan, 2017). These curricular approaches can also provide opportunities to disrupt dominant narrative structures creating opportunities for students to see, or not see their own lives and communities within the curriculum (Leonard, 2018).

Translanguaging is developing as an increasingly viable technique for practices in classrooms where students and teachers interact in multiple languages, as well as other semiotic resources, to co-construct and share their mathematical ideas. In this regard, using translanguaging for collaborative reasoning not only exercises students' existing linguistic resources, but, in English-medium contexts, it becomes a tool for engagement for ethnic minority students who may feel alienated from traditional mathematics, while also linking disciplinary knowledge to culture (Tai, 2021).

2.5. Challenges and opportunities in culturally relevant pedagogy

The beliefs and expectations of teachers have significant influences over the capacity to enact equitable practices in the classroom. High expectations and positive beliefs are important in assuring students receive adequate support, but implicit biases or low expectations especially in online or remote learning settings can lead to inequitable results (Acquah *et al.*, 2015; Yılmaz *et al.*, 2021). These topics reinforce the need for teachers to reflect upon, and receive professional development about, increasingly becoming aware and culturally responsive.

Culturally relevant pedagogy often faces barriers related to perceived lack of knowledge, a sense of insecurity at being able to use relevant pedagogy effectively, and resistance from teachers and dimensions of schooling. Using the concept of resistance, or reluctance, to culturally relevant pedagogy can instead be framed as a learning opportunity and therefore targeted intervention can be put in place that fosters collegiality and allows teachers to increase their practice within a community of other educators (Neri *et al.*, 2019).

Teaching that respects students' cultures and helps promote academic success is culturally responsive (Harding-DeKam, 2014; Leonard, 2018). Expatriate professors in Saudi Arabian institutions of higher education have not changed their teaching designation for diverse cultures. There is evidence that culturally responsive teaching practices can promote deeper learning and help students grow academically and culturally (Hamdan Alghamdi, 2014).

2.6. Case studies in diverse educational contexts

The experiences of African immigrant children within U.S P-12 schools underscore the value of culturally responsive teaching. They may encounter uncomfortable educational situations that might impede their learning yet knowing their experiences prior to migration can better inform the teaching practices to support their learning (Hamdan Alghamdi, 2014; Ndemanu & Jordan, 2017)

In rural and tribal classrooms, culturally appropriate teaching has allowed teachers to create mathematics instruction that is culturally relevant, in part by honoring local traditions and language. These cases illustrate the successful implementation of multicultural pedagogy in cultural and geographic contexts (Leonard, 2018).

The national curriculum reform in Finland serves as a prominent example of an educational strategy for the implementation of multicultural education in the education system. Over the last two decades, the curriculum has gradually begun to emphasize equity and inclusion, with the goal of preparing students to be ethical, respectful, and open-minded. Although Finland can point to progress being made in the name of equity and inclusion, examples also illustrate the difficulties of sustaining this type of reform (Acquah *et al.*, 2015; Zilliacus *et al.*, 2017).

2.7. Integrating ethnomathematics and local knowledge

2.7.1. Understanding ethnomathematics in mathematics education

Ethnomathematics shows us how mathematics is culture bound and shows how many people see mathematics being shaped by their own ideas to construct an understanding of mathematics and its meaning. Ethnomathematics originates from Greek words which mean, "people," "knowledge," and "study". It emphasizes that mathematics is situated and takes on many forms depending on society and age (D'Ambrosio, 1985; Rosa & Orey, 2016). More broadly, these attempts to engage in the study of mathematics compliments education to understand and value non-Western traditions and recognize that there are many free identities of understanding mathematics.

Ethnomathematics establishes a link between mathematics and students' lives and cultural practices, which helps make the subject accessible for students. In Nepal, students are more engaged and confident about mathematics when teaching and learning activities incorporate localized culture and practices (Acharya *et al.*, 2021). Students also find mathematics to be more interesting and easier to learn when they incorporate the customs of their locale (Acharya *et al.*, 2021). Ethnomathematics can also mitigate the disconnect that arises from formalized, standardized, culturally neutral instruction within the classroom (Leonard, 2018).

The inclusion of Indigenous knowledge systems as a part of

sustainability education is a deeper, applied manifestation of ethnomathematics. Looking through another lens on science, which may include Indigenous knowledge systems, Eastern Buddhist thought, and the post-human, allows educators to open the door to promote pluralistic worldviews and intercultural understandings (Zidny *et al*., 2020).

2.7.2. Benefits of incorporating local and indigenous knowledge

Introducing cultural traditions and scientific content into the classroom context serves to help students see the value of their cultures in relation to the curriculum. The evidence supports this enhances the learning of all scholars by leveraging diversity as an avenue to understand (Sotero *et al*., 2020). It is a key role of teachers to make the connection between what students know from their experiences to the formal curriculum in order to make lessons relevant and engaging (Gay, 2010).

Integrating local and Indigenous knowledge into classrooms bolsters intercultural awareness and expands the ability for students to understand the world more holistically. It leads to learning derived from the real context of communities, links education to local ways of knowing, provides a context for sustainability, and reflects and honors culturally diverse experiences (Zidny *et al*., 2020)

Facilitating students' identity and ways of learning through local contexts not only increases student engagement but also endorses their cultural identity (Gay, 2010; Ng'asike, 2014). Evidence from nomadic pastoralist communities in Kenya provides evidence of the benefits of situating early childhood education in Indigenous developmental standards and models, which are engaged in relation to practical realities, academic language, cultural agendas, and a community's conception of learning (Ng'asike, 2014).

2.7.3. Challenges and practical considerations

While there are potential advantages in connecting ethnomathematics and local knowledge, there are also pragmatic limitations. Often, teacher preparation programs do not include the content and resources teachers need to connect local cultural perspectives effectively (Gay, 2010; Panthi & Belbase, 2017). In Nepal, for example, limited curricula, technological supports, and professional development are limiting provisions for a culturally specific mathematics learning environment (Panthi & Belbase, 2017).

To be effective in this integration, schools must have close connections to their local communities. Research shows that educators' engagement with members in the wider community leads to more intimate and collaborative engagement with community members that includes diverse knowledge systems into the learning context more authentically and more completely (Sotero *et al*., 2020). The relational aspect of education is critical for creating culturally responsive and culturally appropriate pedagogy (Gay, 2010).

Language justice issues shift focus to curricula that embrace linguistic diversity, and also recognizes all students as more equally participating in the learning experience. Addressing issues of equity in education involves confronting structural inequities that are woven into language policy, resources, and implementation in the classroom; each of these structural inequities ultimately impacts the students access and achievement (Jurado de los Santos *et al*., 2020).

2.8. Pedagogical practices supporting multicultural mathematics learning

2.8.1. Active and inquiry-based learning approaches

Active learning is of benefit to students, especially in the STEM disciplines where normal lecturing can sometimes cause students to be disengaged rather than engaged (Freeman *et al*., 2014; Aji & Khan, 2019). In a multicultural classroom, inquiry-based science education can be integrated with culturally relevant pedagogy for students to explore scientific concepts through multiple cultural constructs of knowledge, such as indigenous knowledge and family knowledge traditions. The inquiry-based option would cultivate sociopolitical consciousness and potentially incorporate authentic and relatable dimensions of students learning in multicultural contexts (Brown, 2017). Another example is collaborative, conversational classroom instructional strategies, like reciprocal teaching, to engage students in learning experiences that can include the concept of meaning participation that foster developing key comprehension skills and meta-cognition in mathematics. Either of these options will have students engaged in terms of developing their understanding as participants in the learning activity, not merely as spectators (McAllum, 2014).

2.8.2. Translanguaging and multimodal instruction

Translanguaging pedagogy utilizes students' total linguistic resources to stimulate more substantial learning in mathematics. In contrast to typical bilingual approaches, translanguaging pedagogy acknowledges that a learner's languages can all be harnessed to promote learning (García & Wei, 2014). Studies that take place in English-medium settings, focused on minority South Asian learners, showcase the potential for translanguaging strategies to enhance the access, and relevancy of mathematics learning (Tai, 2021). The translanguaging approach is committed to equity because it expands on the concepts related to cultural and linguistic diversity and to the barriers in learning and participating often caused by the mono linguistic approach. It creates a valuing of linguistic diversity by involving the language activities of students and also collective cultural knowledge to establish a common understanding of mathematics and science in the classrooms (Cenoz & Gorter, 2020; Tai, 2021). The multimodal facets of translanguaging, which give space to allow for different verbal and non-verbal communication modes and for flexible expression and cognitive development in learners. Research shows that the teaching strategy increases the degree to which learners are engaged, understand and are cognizant of the equity measures taken in the diverse classrooms with cultural and linguistic variety (García & Wei, 2014).

2.8.3. Inclusive practices for students with disabilities and diverse needs

Mathematics educators have varied opinions and experiences with teaching students with disabilities. Research reveals

differences in knowledge, beliefs, and support for inclusive practices among educators, indicating a need for professional development and additional resources to ensure meaningful inclusive mathematics education for students with disabilities (Moreira & Manrique, 2014; Florian & Black-Hawkins, 2011).

Educators can help all learners to learn mathematics through creating learning environments that are differentiated, mediated through different representations of the concept, and using technology that is able to engage students in a manner proximal to their learning profile. Fairness is achieved by removing barriers experienced by learners with special educational needs to enable meaningful access (Nortvedt *et al.*, 2020; UNESCO, 2017).

Assessment practices must be developed such that they honor individual differences without generally marginalizing students who come to math classrooms with cultural or language differences, as also articulated in the principles noted in the Salamanca Statement (UNESCO, 1994). Culturally responsive assessment acknowledges the varied ways of knowing and expressing one's understanding of mathematics and that work to support a learner's place in being included and to an equity in the ways the assessment is structured (Nortvedt *et al.*, 2020).

In the Philippines, inclusive education is overall endorsed through not only policy but legislation such as DepEd Order No. 72 (DepEd, 2009), and Republic Act No. 11650 (Republic of the Philippines, 2022), both of which sanction institutions of learning to provide alternatives to support students with disabilities.

2.9. Assessment and equity in multicultural mathematics education

2.9.1. Culturally responsive assessment practices

Culturally sensitive assessment methods acknowledge that traditional assessments may not reflect the full range of mathematical skills for all students, especially for migrant students and those from diverse cultures. Teachers and schools often have a problem adjusting both formative and summative assessments to the cultural ways in which children learn (Nortvedt *et al.*, 2020; UNESCO, 2017). Assessing students in valid and reliable ways takes into account the diversity of experiences of learners. Successful assessment also requires teacher awareness, support from the institution, and policies that allow flexibility for teachers (Nortvedt *et al.*, 2020; Florian & Black-Hawkins, 2011).

The formative assessment provides ongoing feedback and opportunities for reflection, which makes it ideally suited for culturally responsive practices if it recognizes different communications styles and cultural experiences within mathematics learning (Nortvedt & Buchholtz, 2018; UNESCO, 1994). Inclusive zeroing assessment practices are also more relevant in the Philippine context due DepEd Order No. 72 (DepEd, 2009) and Republic Act No. 11650 (Republic of the Philippines, 2022). These documents provide institutional recognition for learners with needs variation.

2.9.2. Methodological issues in mathematics assessment

Developing assessments that truly reflect the depth of students' knowledge is a difficult task, especially considering the varying cultural and linguistic backgrounds of each learner. The challenge is further complicated when those assessments seek to measure higher-order skills such as problem solving, critical thinking, and authentic application of knowledge to real experiences (Nortvedt & Buchholtz, 2018). The ability to connect assessment data to educational policy and classroom practice also requires appropriate consideration and careful examination and transparency to avoid misrepresenting individuals and their learning, as equally the possibility of repeating inequities, downplaying the authenticity of student learning (Nortvedt & Buchholtz, 2018). The ongoing achievement and gender gaps reflect systemic failings of educational practice too. Moreover, developed assessments based on conjecture, that are analyzed without due attention to intersectional identities, indicate an urgent need for assessments that are equitable, reflect the value of diversity, and respond to the complex nature of students' identities (Nortvedt & Buchholtz, 2018).

2.9.3. Supporting equity through assessment policy and practice

Teachers and policymakers have important roles in ensuring that assessments support equitable outcomes. To implement culturally responsive assessments, it is important teachers are trained and supported with the correct materials while policymakers have developed systems that encourage and support teachers with their practices (Nortvedt & Buchholtz, 2018).

Some barriers to implementing more inclusive assessment strategies include the lack of awareness of undertaking more inclusive assessments, the lack of resources available to be able to take these assessments, and the institutional pressure to have more conventional assessments. However, where there are training, community support, and clear/concise policies, assessments can create more inclusive practices (Neri, *et al*, 2019). If assessments are to be seen as a tool for inclusive and transformational practice, there needs to be a shift away from punitive and/or solely accountability models and toward models that center learning, growth, and equity for students (Nortvedt, *et al.*, 2020).

2.10. Teacher preparation and professional development

2.10.1. Teacher knowledge and awareness of cultural diversity

Research suggests that even in the twenty-first century main stream teachers respond in various ways to cultural diversity and language difference and even the best teachers must provide for the needs of the individual through the provision of resources and appropriate strategies (Acquah *et al* 2015). Training helps to educate teachers to be aware of the cultural strengths of their students, how best to accommodate for the language difference and to modify their practice for effective multicultural mathematics instruction and further helps them to be aware of their own biases, assumptions and understandings which help to create fair-minded and equitable learning environments (Acquah *et al.*, 2015). Awareness of the diversity of the educators is thought to correlate to successful implementation of inclusive strategies which can be the basis of happening of the equitable outcomes found in class room situations (Acquah *et al.*, 2015).

2.10.2. Preparing teachers for culturally relevant mathematics instruction

Building teachers' pedagogical content knowledge for multilingual settings should focus on incorporating culturally relevant practices and curricula into teacher education programs. This preparation increases teachers' ability to engage mathematical content in ways that are connected to their students' cultural backgrounds and to address systemic inequities in educational settings (Leonard, 2018). Expatriate and international teachers face identifiable challenges, as noted in contexts similar to Saudi Arabian higher education, that often require support and professional development to teach in culturally responsive ways (Hamdan Alghamdi, 2014). Sustaining teacher effectiveness in multicultural mathematics education also requires ongoing training and curriculum support (Harding-DeKam, 2014).

2.10.3. Sustainable development and equity in teacher education programs

Global movements, such as the Sustainable Development Goal 4, have emphasized quality, equity, and inclusion in education; therefore, equity and inclusion must be embedded in teacher education programs globally.

Preparation of teachers for supporting SEN learners and other learners from diverse cultural and linguistic backgrounds has been an important component of effective teacher preparation. However, several studies have identified gaps in most courses, hence leading to the call for change in approach (Nketsia, 2016; Nketsia *et al.*, 2020; UNESCO, 2017).

Effective teacher preparation puts educators in a position to respond to the needs of SEN students and students from diverse cultural and linguistic backgrounds. Evidence demonstrates that very many courses fall short in these regards, which constitutes the need for reform (Nketsia, 2016; Nketsia *et al.*, 2020; UNESCO, 2017).

2.11. Technology and emerging tools for multicultural mathematics education

Digital tools like robotics, spatial visualization applications, AR/VR platforms, and other learning technologies open new avenues for culturally responsive teaching in mathematics classrooms. These technologies are not only vehicles for content delivery; they can also help connect research with practice in classroom-teaching contexts, as well as provide environments that respond to and reflect the cultural backgrounds of the learners (Leonard, 2018; Bertrand *et al.*, 2024). They support student access to culturally relevant materials and allow multicultural orientations to surpass the limitations of the relevant instructional approaches (Morales-Chicas *et al.*, 2019; Owen & Pearson, 2025).

The unexpected shift toward online learning during the COVID-19 pandemic showed many how longstanding inequality in education had been. Students' access to and use of technology for mathematics learning were influenced by income, language, and cultural differences, often widening existing gaps (Yılmaz *et al.*, 2021; Owen & Pearson, 2025). Such inequities were even more evident in remote settings where restrictions on resources or barriers related to culture or language impeded fair participation. Schools need to have stated policies on better infrastructure and support systems that ensure equity and accessibility in technology use if they want to reduce these inequities (Owen & Pearson, 2025).

Research on culturally responsive K–12 computing shows that students learn best when lessons are made relevant to their own lives through the investigation of social problems, respect for their cultural heritage, relating content to day-to-day experience, leveraging knowledge they already possess, engaging the community and accommodating the teaching to the needs of each student. These methods place marginalized students in genuine authority, using technology as a means toward equity and social justice (Morales-Chicas *et al.*, 2019; Bertrand *et al.*, 2024; Owen & Pearson, 2025). Cultural responsiveness in the teaching and learning of technology authentically contextualizes the learning for the student, enhancing critical thinking, increasing social awareness, and more significantly, maintaining student engagement.

When approached in a thoughtful manner, technologies have the potential to increase student engagement, and when we couple it with culturally relevant content, educators widen spaces to learn mathematics in grounded ways. Ensuring equity of access, preparing teachers for appropriate support, and integrating digital technologies with culturally responsive teaching enables schools to offer mathematics that is inclusive, empowering, and socially responsible (Leonard, 2018; Morales-Chicas *et al.*, 2019; Bertrand *et al.*, 2024; Owen & Pearson, 2025).

Blending technology with culturally responsive teaching and fair assessments enables teachers to create math classrooms that include all learners, keep them engaged, and show how math relates to their cultures and everyday experiences.

2.12. Sociopolitical dimensions and social justice in mathematics education

2.12.1. Addressing oppression and social stratification

Mathematics education provides a key site for contesting forms of social stratification about race, class, and gender. With education related to these forms of oppression, social justice can serve as a primary goal, and the teaching of mathematics may connect to concerns of a critical social nature (Leonard, 2018; Neri *et al.*, 2019).

When topics such as Black Lives Matter are incorporated into math instruction, the classroom is made more relevant and empowering for students that is based on lived experiences. Math can also foster critical thinking skills of the students by encouraging students to investigate and interrogate social inequalities.

2.12.2. Citizenship and critical thinking through mathematics

Increasingly, citizenship education is being introduced in math teaching as a means to foster critical thinking, justice, and active civic engagement mathematics can also be used to provide students with deeper understandings of sociocultural issues and motivate them to become informed and active citizens (Geiger *et al.*, 2023; Brown, 2017).

Policy frameworks, curricula, and the landscape of a constantly

changing society are central to mathematics education. In a constantly changing environment, mathematics learning must be about more than developing technical skills; instead, it requires the development of students' abilities to think critically, solve problems, and engage thoughtfully with complex real-world problems (Geiger *et al.*, 2023). Under this view, mathematics is not just an academic discipline but a significant vehicle for developing thoughtful, reflective, and responsible citizens (Neri *et al.*, 2019).

2.12.3. Leadership and institutional support for culturally responsive education

Culturally responsive leadership lies at the heart of fostering equity and inclusion in schools. Leadership fosters institutional change by valuing diversity, promoting inclusion, and navigating the challenges of multicultural education (Brown *et al.*, 2021). To realize culturally responsive teaching, school leaders will need to build the skills, practices, and structures that will foster equity while leading broader social change (Brown *et al.*, 2021; OECD, 2019).

Sustainable change occurs through the interrelationship of professional learning and policy see the development of culturally responsive practices at all levels of the system (Neri *et al.*, 2019). The sociopolitical, cultural, and leadership processes highlighted here point to the interconnectivity of equitable mathematics education across contexts. The practice of teaching well extends beyond the practice of teaching well, it is about inspiration to address social inequities that contribute to civic engagement and cultural responsiveness at all levels of the educational system; and provides a framing to summarize thinking, talk about persistent challenges, and explore pathways for more socially just mathematics education.

3. METHODOLOGY

This paper uses a narrative literature review method to review multicultural perspectives in mathematics education. Relevant studies were found in academic databases such as Google Scholar, Scopus, Sage Journals, Springer Nature Link, WILEY Online Library, Web of Science, and ERIC using the following key words: "multicultural mathematics education," "culturally responsive teaching," "ethnomathematics," and "equity in mathematics education." Peer-reviewed journal articles, books, and influential theoretical works published in between 2010 and 2024 were prioritized. We also included earlier seminal sources to provide historical and theoretical context.

The literature was investigated and organized thematically, rather than chronologically, with respect to key themes including equity, culturally responsive pedagogy, local knowledge, assessment, teacher prep, technologies, and the sociopolitical. Thematic synthesis provided a lens through which to critically compare perspectives and practice, and highlight gaps in the literature. It highlighted that teacher implementation of multicultural education has the power to create equitable and open mathematics for all students.

4. RESULTS AND DISCUSSION

Research indicates that multicultural approaches are not merely optional but rather necessary in the development of mathematics education that is equitable, inclusive, and socially just. There are many studies that show a tension in the classroom between traditional standardized teaching and those that focus on students' identities, experiences, and ways of knowing from their communities. Although sociocultural learning, critical pedagogies, and ethnomathematics, among others, strongly recognize the value of bringing culture into math teaching, enacting these approaches in math classrooms is often difficult. Common barriers and challenges to developing equitable math teaching relate to school resistance, unprepared teachers, and standardized assessments oriented toward dominant norms and values that favor mainly white models.

This review documents that equity issues, including racial, gendered, linguistic, and socioeconomic disadvantage, are connected and cannot be dealt with individually. For example, translanguaging allows students to access and navigate their language barriers, which it turns out, is contingent on teachers who are knowledgeable about their students' languages and have access to institutional policies that support multilingual modalities in their teaching. Similarly, ethnomathematics and the power of Indigenous knowledge, may not be supported because of narrow curricular pathways and a lack of representative materials. These examples illustrate a need for coordinated action among and commitment to interactivity of teaching practice, teacher development, and policy implementation. The literature shows that multicultural mathematics education should not only lead to symbolic inclusion, but change practice altogether, and that the field should find ways to connect our more than one cultural way of knowing with our rigorous mathematics content standards, such that access and inclusivity is truly an enhancement to student experiences and learning and not a limitation.

This review managed to answer the four main research questions through the integration of 43 peer-reviewed studies from various sociocultural and educational backgrounds. To begin with, the analysis indicated that multicultural, culturally responsive, and culturally relevant pedagogies profoundly affect the mathematics learning process by associating instruction with the cultural identities, community practices, and lived experiences of the students, thus promoting engagement and understanding of the concept. In the second place, the existing literature pointed out various equity-related difficulties such as the existence of language barriers, unfair assessment practices, institutional resistance, and teacher preparedness gaps as things that would not allow multicultural mathematics education to be implemented in full. The literature's third point was a variety of techniques like ethnomathematics, translanguaging, inquiry-based learning, inclusive practices for diverse learners, and technology-enhanced instruction-all providing the ground for mathematics learning to be culturally rooted and fair. Lastly, the review emphasized the extent of social-political contexts and the nature of social justice orientations in the choice of the direction of mathematics education as it concerns policy-setting, teaching practices, and the preparation of promoting critical, empowered, and socially conscious learners as the ultimate goal. All in all, the study results confirm that there has been a considerable amount of progress, but still, the application of systemic, pedagogical, and institutional

efforts, in the long run, is a must to realizing a truly equitable multicultural mathematics education.

5. CONCLUSION

This review is intended to demonstrate that multicultural mathematics can also be beneficial for all students in ways that foster equity and social justice. By employing culturally relevant pedagogy, ethnomathematics, inclusive assessment, meaningful teacher education, and purposeful use of technology, the teacher is able to construct classrooms that honor students' cultures and make learning mathematics more relevant, applicable, and accessible for all students.

There are challenges to face, particularly in teacher preparation, institutional barriers, and procedures for ensuring equitable protocols. The literature advocates for a variety of ways of moving forward. In mathematics education, culture is not an add-on, but part of making education meaningful, relevant, and empowering. Ultimately, multicultural mathematics education aims to cultivate students who are not only confident in mathematics, but also socially aware, critical, and prepared to participate in equitable and inclusive communities.

REFERENCES

Acharya, B. R., Kshetree, M. P., Khanal, B., Panthi, R. K., & Belbase, S. (2021). Mathematics educators' perspectives on cultural relevance of basic level mathematics in Nepal. *Journal on Mathematics Education, 12*(1), 17–48. https://doi.org/10.22342/jme.12.1.12955.17-48

Acquah, E. O., Tandon, M., & Lempinen, S. (2015). Teacher diversity awareness in the context of changing demographics. *European Educational Research Journal, 15*(2), 218–235. https://doi.org/10.1177/1474904115611676

Aji, C. A., & Khan, M. J. (2019). The Impact of Active Learning on Students' Academic Performance. *Open Journal of Social Sciences, 07*(03), 204–211. https://doi.org/10.4236/jss.2019.73017

Bertrand, M. G., Sezer, H. B., & Namukasa, I. K. (2024). *Exploring AR and VR Tools in Mathematics Education Through Culturally Responsive Pedagogies.* Digital Experiences in Mathematics Education. https://doi.org/10.1007/s40751-024-00152-x

Brown, J. C. (2017). A metasynthesis of the complementarity of culturally responsive and inquiry-based science education in K-12 settings: Implications for advancing equitable science teaching and learning. *Journal of Research in Science Teaching, 54*(9), 1143–1173. https://doi.org/10.1002/tea.21401

Brown, M., Altrichter, H., Shiyan, I., Rodríguez Conde, M. J., McNamara, G., Herzog-Punzenberger, B., Vorobyeva, I., Vangrando, V., Gardezi, S., O'Hara, J., Postlbauer, A., Milyaeva, D., Sergeevna, N., Fulterer, S., García, A. G., & Sánchez, L. (2021). Challenges and opportunities for culturally responsive leadership in schools: Evidence from Four European countries. *Policy Futures in Education, 20*(5), 580–607. https://doi.org/10.1177/14782103211040909

Cenoz, J., & Gorter, D. (2020). Teaching English through pedagogical translanguaging. *World Englishes, 39.* 300-311. https://doi.org/10.1111/weng.12462.

D'ambrosio, U. (1985). Ethnomathematics and its Place in the History and Pedagogy of Mathematics. *Mathematics, 5*, 44-48.

Florian, L., & Black-Hawkins, K. (2011). Exploring Inclusive Pedagogy. *British Educational Research Journal, 37*(5), 813–828. https://doi.org/10.1080/01411926.2010.501096

Freeman, S., Eddy, S. L., McDonough, M., Smith, M. K., Okoroafor, N., Jordt, H., & Wenderoth, M. P. (2014). Active learning increases student performance in science, engineering, and mathematics. *Proceedings of the National Academy of Sciences, 111*(23), 8410–8415. https://doi.org/10.1073/pnas.1319030111

Garcia, O., & Wei, L. (2014). *Translanguaging: Language, Bilingualism, and Education.* New York, NY: Palgrave MacMillan. https://doi.org/10.1057/9781137385765

Gay, G. (2019). Culturally Responsive Teaching 9780807758762. Teachers College Press. Tcpress.com. https://www.tcpress.com/culturally-responsive-teaching-9780807758762

Geiger, V., Gal, I., & Graven, M. (2023). The connections between citizenship education and mathematics education. *ZDM – Mathematics Education, 55*(5), 923–940. https://doi.org/10.1007/s11858-023-01521-3

Hamdan Alghamdi, A. K. (2014). The Road to Culturally Relevant Pedagogy: Expatriate teachers' pedagogical practices in the cultural context of Saudi Arabian higher education. *McGill Journal of Education, 49*(1), 201. https://doi.org/10.7202/1025778ar

Harding-DeKam, J. L. (2014). Defining culturally responsive teaching: The case of mathematics. *Cogent Education, 1*(1). https://doi.org/10.1080/2331186x.2014.972676

July 6, 2009 DO 72, s. 2009 – Inclusive Education as Strategy for Increasing Participation Rate of Children. (n.d.). Department of Education. https://www.deped.gov.ph/2009/07/06/do-72-s-2009-inclusive-education-as-strategy-for-increasing-participation-rate-of-children/

Jurado de los Santos, P., Moreno-Guerrero, A.-J., Marín-Marín, J.-A., & Soler Costa, R. (2020). The Term Equity in Education: A Literature Review with Scientific Mapping in Web of Science. *International Journal of Environmental Research and Public Health, 17*(10), 3526. https://doi.org/10.3390/ijerph17103526

Ladson-Billings, G. (1995). Toward a Theory of Culturally Relevant Pedagogy. *American Educational Research Journal, 32*(3), 465–491. https://doi.org/10.3102/00028312032003465

Leonard, J. (2018). *Culturally Specific Pedagogy in the Mathematics Classroom.* Routledge. https://doi.

org/10.4324/9781351255837

McAllum, R. (2014). Reciprocal Teaching: Critical Reflection on Practice. *Kairaranga, 15*(1), 26–35. https://doi.org/10.54322/kairaranga.v15i1.183

Morales-Chicas, J., Castillo, M., Bernal, I., Ramos, P., & Guzman, B. (2019). Computing with Relevance and Purpose: A Review of Culturally Relevant Education in Computing. *International Journal of Multicultural Education, 21*(1), 125. https://doi.org/10.18251/ijme.v21i1.1745

Moreira, G. and Manrique, A. (2014) Challenges in Inclusive Mathematics Education: Representations by Professionals Who Teach Mathematics to Students with Disabilities. *Creative Education, 5*, 470-483. https://doi.org/10.4236/ce.2014.57056.

Ndemanu, M. T., & Jordan, S. (2017). Culturally Responsive Pedagogy for African Immigrant Children in U.S. P-12 Schools. *Journal of Black Studies, 49*(1), 71–84. https://doi.org/10.1177/0021934717736065

Neri, R. C., Lozano, M., & Gomez, L. M. (2019). (Re)framing Resistance to Culturally Relevant Education as a Multilevel Learning Problem. *Review of Research in Education, 43*(1), 197–226. https://doi.org/10.3102/0091732x18821120

Ng'asike, J. T. (2014). African Early Childhood Development Curriculum and Pedagogy for Turkana Nomadic Pastoralist Communities of Kenya. *New Directions for Child and Adolescent Development, 2014(146)*, 43–60. https://doi.org/10.1002/cad.20072

Nketsia, W. (2016). *Teacher Educators' Views on Inclusive Education and Teacher Preparation in Ghana.*

Nketsia, W., Opoku, M. P., Saloviita, T., & Tracey, D. (2020). Teacher Educators' and Teacher Trainees' Perspective on Teacher Training for Sustainable Development. *Journal of Teacher Education for Sustainability, 22*(1), 49–65. https://doi.org/10.2478/jtes-2020-0005

Nortvedt, G. A., & Buchholtz, N. (2018). Assessment in mathematics education: responding to issues regarding methodology, policy, and equity. *ZDM, 50*(4), 555–570. https://doi.org/10.1007/s11858-018-0963-z

Nortvedt, G. A., Wiese, E., Brown, M., Burns, D., McNamara, G., O'Hara, J., Altrichter, H., Fellner, M., Herzog-Punzenberger, B., Nayir, F., & Taneri, P. O. (2020). Aiding culturally responsive assessment in schools in a globalising world. *Educational Assessment, Evaluation and Accountability, 32*(1), 5–27. https://doi.org/10.1007/s11092-020-09316-w

Owen, O., & Pearson, J. (2025). Emerging Trends in Digital Tools for Mathematics Learning: Implications for Equity, Access, and Achievement. https://doi.org/10.2139/ssrn.5400198

Panthi, R. K., & Belbase, S. (2017). *Teaching and Learning Issues in Mathematics in the Context of Nepal.* www.preprints.org. https://doi.org/10.20944/preprints201706.0029.v1

Republic Act No. 11650 | GOVPH. (n.d.). *Official Gazette of the Republic of the Philippines.* https://www.officialgazette.gov.ph/2022/03/11/republic-act-no-11650/

Robertson, S.-A., & Graven, M. (2019). Language as an including or excluding factor in mathematics teaching and learning. *Mathematics Education Research Journal, 32*(1), 77–101. https://doi.org/10.1007/s13394-019-00302-0

Rosa, M., & Orey, D. C. (2016). *State of the Art in Ethnomathematics.* ICME-13 Topical Surveys, 11–37. https://doi.org/10.1007/978-3-319-30120-4_3

Sotero, M. C., Alves, Â. G. C., Arandas, J. K. G., & Medeiros, M. F. T. (2020). Local and scientific knowledge in the school context: characterization and content of published works. *Journal of Ethnobiology and Ethnomedicine, 16*(1). https://doi.org/10.1186/s13002-020-00373-5

Tai, K. W. H. (2021). Translanguaging as Inclusive Pedagogical Practices in English-Medium Instruction Science and Mathematics Classrooms for Linguistically and Culturally Diverse Students. *Research in Science Education, 52.* https://doi.org/10.1007/s11165-021-10018-6

Tanase, M. F. (2021). Culturally responsive teaching in urban secondary schools. *Education and Urban Society, 54*(4), 001312452110266. https://doi.org/10.1177/00131245211026689

The lives of teachers in diverse classrooms. (2019). *OECD Education Working Papers.* https://doi.org/10.1787/8c26fee5-en

UNESCO. (1994). *The salamanca statement and framework for action on special needs education.* Unesco. https://unesdoc.unesco.org/ark:/48223/pf0000098427

UNESCO. (2017). *A guide for ensuring inclusion and equity in education.* UNESCO. https://unesdoc.unesco.org/ark:/48223/pf0000248254

Yılmaz, Z., Gülbağcı Dede, H., Sears, R., & Yıldız Nielsen, S. (2021). Are we all in this together?: mathematics teachers' perspectives on equity in remote instruction during pandemic. *Educational Studies in Mathematics, 108*(1-2), 307–331. https://doi.org/10.1007/s10649-021-10060-1

Zidny, R., Sjöström, J., & Eilks, I. (2020). A Multi-Perspective Reflection on How Indigenous Knowledge and Related Ideas Can Improve Science Education for Sustainability. *Science & Education, 29*(1), 145–185. https://doi.org/10.1007/s11191-019-00100-x

Zilliacus, H., Holm, G., & Sahlström, F. (2017). Taking steps towards institutionalising multicultural education – The national curriculum of Finland. *Multicultural Education Review, 9*(4), 231–248. https://doi.org/10.1080/2005615X.2017.1383810