Teaching mathematics through a cultural lens: Allowing students to resonate the academic content

Angga Hidayat
STEM Education, The Ohio State University, The United States of America
* Corresponding Author. Email: hidayat.8@osu.edu

Received: 26 August 2023; Revised: 16 September 2023; Accepted: 19 September 2023

Abstract: Indonesia is a country of diversity, with a variety of different cultures incorporated into the national identity. With a great range of cultural groups existing in Indonesia, it is essential for teachers to implement a cultural approach in their mathematics classes to ensure that students from all backgrounds have the opportunity to learn and understand the academic content. This article intends to explore the topics of multicultural education in mathematics classrooms. It has been found in the pieces of literature available that an appreciation of cultural dissimilarities can be beneficial and should be seen as an advantage rather than a shortcoming. To accommodate this peculiarity, there are strategies that can be utilized such as funds of knowledge, ethnomathematics, and also storytelling within mathematics lessons. These strategies grant teachers multiple methods of preserving culture while at the same time teaching mathematics effectively and efficiently.

Keywords: Cultural diversity, Ethnomathematics, Funds of knowledge, Mathematics storytelling, Multicultural education


INTRODUCTION

Indonesia is a nation renowned for its vast array of cultures, and among the world's most culturally diverse countries. This has led to various scholars striving to give a voice to groups belonging to all cultural groups, to promote equity within society. Various cultures aspire to have the same rights and opportunities in a society that is becoming increasingly diverse. However, enacting these changes can be challenging, since the dominant culture usually holds more power within society.

The increasing diversity among students has also had an impact on mathematics education (Cobb & Hodge, 2002). When all students in a class share similar abilities, learning styles, and cultural backgrounds, teaching mathematics can be relatively straightforward. However, because Indonesian students come from a variety of backgrounds, cultures, and learning styles, mathematics teachers must put in more effort to ensure that each student fully grasps the lesson without any feeling left behind (d'Entremont, 2015). In other words, educators must take into account the range of diverse cultures in the classroom (Ladson-Billings, 1992) when planning their instruction to provide an equal opportunity to succeed in mathematics.

It is essential that in a multicultural mathematics classroom, teachers employ strategies that allow students to progress based on their cultural background. This means that the teachers must take care to ensure that the teaching methods used can help all students succeed. Thus, the purpose of this article is to describe research surrounding multicultural education in mathematics classroom. Specifically, I will address the following two questions:
1. What are the critiques to multicultural education?
2. How to incorporate cultural lens in mathematics classrooms?

METHOD

This study falls within the realm of library research, which entails a comprehensive examination of various documents (Mann, 1993). The researchers play a crucial role in uncovering information related to the subjects they are investigating, which, in this case, revolve around the multicultural aspects of mathematics education. In this type of research, concerns about potential bias always exist, and the researchers have taken measures to minimize any such biases. Although the analysis likely drew upon a wide range of sources, it is possible that the researchers deliberately focused on a specific group of documents that they considered most relevant and informative for addressing the research questions.

RESULTS AND DISCUSSION

Critiques of Multicultural Education

While there is a lack of discussion on the relationship between curriculum models and multiculturalism (Sleeter & Grant, 1987), existing research does provide some insights. For example, a study by (Davis, 1995) found that hidden curricula can play a role in reinforcing or challenging multiculturalism. The hidden curriculum describes the countless non-academic components that influence student learning in schools. While there is a well-defined curriculum, teachers are expected to present within the scope of their lessons, research indicates that students absorb unexpected nuances during their educational experience as well (Small, 2020). Unofficial messages, such as ethnic identity in classrooms, can shape pupil values and mindsets just as effectively as a more formal agenda. Overall, defining and understanding the dispersion of the hidden curriculum remains an ongoing challenge for researchers and educators alike. From a multicultural perspective, the hidden curriculum can help to increase student achievement, promote inclusivity and understanding of different cultures. However, it can also inadvertently reinforce stereotypes and outside prejudices (Abd Elkader, 2016).

It is important that students have the opportunity to learn about and discuss diversity in all areas of the curriculum, “not just in a particular time of the day” (Lewison et al., 2002). However, many schools lack a curriculum that allows for this type of discussion (Sleeter & Grant, 1987). As a result, students are not able to talk about and write about the power issues and inequality that exist in our society. This lack of discussion leaves students ill-prepared to deal with the challenges of our increasingly diverse world. It is therefore essential that educators view existing curriculum from a multicultural perspective (Sleeter & Grant, 1987).

Another criticism of multicultural education is its effectiveness in achieving equity and excellence in education through curriculum transformation (Bennett, 2001). This is primarily due to limited research on the matter. Critics argue that this lack of research proves that multicultural education has failed to fulfill its early promise to level the playing field (Bennett, 2001). The need for more inclusive and diverse multicultural education has emerged as a response to the increased awareness of the importance of equity in school ecology (Abd Elkader, 2016). This includes issues such as administration, teacher recruitment, and enrollment of students in sports and special education. A more inclusive approach to multicultural education is necessary to ensure that all students have an equal opportunity to succeed. Also, single stand-alone courses on multiculturalism can be helpful, but they are not enough to create an equitable school environment (Abd Elkader, 2016). It is important that the administration, teachers, and students all work together to create a respectful and inclusive community.

The possibilities of multicultural education can be optimized through the utilization of complementary frameworks that serve to fill in any inadequacies presented by current conceptions. By providing a more multifaceted educational experience, students from all cultural backgrounds gain access to the same contents, including mathematics contents, yet
through methodologies intelligible to them. This is made possible through the incorporation of diverse pedagogical strategies that bridge the gaps between cultural disparities and ensure an equitable learning environment. Consequently, teachers must remain mindful and abreast of current best practices in order to provide students with a culturally inclusive setting suitable for their academic success.

In the proceeding section, I will present a few frameworks that strive to help compensate for the disparities in ethnic backgrounds in mathematics lessons. As intricate cultural differences can stifle progress and efficiency, it is necessary to craft solutions that bridge these gaps between backgrounds. The discussed frameworks not only aim to build equity among students but also aim to provide a meaningful learning experience. Finding balance among diverse dynamics of math classrooms can be made easier by implementing such frameworks as an effective method for multicultural education.

**Incorporating Cultural Lens in Mathematics Classrooms**

Educators faced with the challenge of addressing inequity in math instruction may find it useful to investigate a number of alternative approaches, specifically but not limited to community funds of knowledge, ethnomathematics, and mathematical storytelling. These strategies may have potential for encouraging equitable learning opportunities when applied in the classroom setting.

**Community Funds of Knowledge**

There is a lack of diversity in the Science, Technology, Engineering, and Mathematics (STEM) area (Denton & Borrego, 2021). This means that students from other ethnicities as well as first-generation and disabled backgrounds are underrepresented. As a result, it is important to design STEM learning environments, particularly in regard to mathematics which forms the core of STEM, in schools that can support the empowerment of underrepresented groups. However, there is a tendency to view the different life experiences of these students as deficits (Denton & Borrego, 2021). It is crucial that educators instead see these differences as assets and highlight them as student strengths. One of the asset-based frameworks that has been gaining traction is the idea of funds of knowledge which emphasizes the integration of student life experiences into educational systems.

The concept of funds of knowledge is that all students have knowledge that they bring with them to school, which is often obtained from their family and community (Moll et al., 1992). This includes not only factual knowledge but also the skills and strategies needed to navigate the world. The idea of funds of knowledge is based on the premise that all students have valuable knowledge that can be used to inform their learning. For example, a student who comes from a family of accountants may have a deep understanding of calculation practices that can be applied in a mathematics class. By emphasizing students’ existing funds of knowledge, educators can create more relevant and engaging learning experiences. Additionally, using funds of knowledge can promote a more culturally responsive curriculum. When students see their own experiences and culture reflected in the material, they are more likely to engage with the content.

In order to find out the knowledge and skills students already have, teachers need to visit students’ homes to interact with the families (Denton & Borrego, 2021). This will give teachers the opportunity to identify students’ home life and interests. Value stories, dialogic listening, and self-determination (San Pedro & Kinloch, 2017a) to engage effectively with families and to ensure that students’ voices are heard. Following the visits, teachers can create new curricula and lesson plans, including in mathematics courses, based on the funds of knowledge they found (Denton & Borrego, 2021).

Additionally, visiting students’ homes can help build relationships between the school and the community. "School-community interactions" (Green, 2017) is important because culture is understood as the shared patterns of behavior and beliefs that people use to make sense of the world around them. These patterns are evident in the everyday activities that people
engage in as members of their communities (Bang et al., 2016). To co-construct and find solutions that take local knowledge and realities (San Pedro & Kinloch, 2017a), educators need to involve community to create an educational system that meets the needs of all cultures (Cobb & Hodge, 2002; d'Entremont, 2015; Nasir et al., 2008).

Ethnomathematics

In a world where math-based technology is becoming increasingly commonplace, it is more important than ever for people to have a strong understanding of mathematics. Unfortunately, many people only think about the mathematics they learned in school when they think about math, which can lead to negative associations with the subject. One way to help mitigate this issue is by redefining school math to be more inclusive of diverse perspectives (Ambrosio, 1985). This can be accomplished through the use of ethnomathematics, or “culturally-based mathematics” (Brandt & Chernoff, 2014). By seeing mathematics from different cultural perspectives, students can become more interested in the subject and see its real-world importance (Brandt & Chernoff, 2014).

Ethnomathematics is a field of study that incorporates elements of ethnography, mathematics, and mathematical modeling (Orey & Rosa, 2006) to gain a deeper understanding of the relationships between mathematics and culture (Ambrosio, 1985; Brandt & Chernoff, 2014; Budiarto et al., 2019; Rowlands & Carson, 2002). Learning about ethnomathematics can help students develop critical thinking and analysis skills that can be applied to everyday life (Orey & Rosa, 2006).

Ethnomathematics is a relatively new field that emerged in the 1970s (Ulum et al., 2018), in part as a response to the Eurocentric bias in mathematics education (Cimen, 2014). The goal of ethnomathematics is to understand mathematics from a diversity of perspectives (Brandt & Chernoff, 2014), and to promote the idea that there is not just one correct way to do mathematics. This is an important perspective, as it challenges the dominant view of mathematics as a universal language with fixed rules. Instead, ethnomathematics acknowledges that mathematics is embedded in culture, and that there are many different ways to mathematical understanding. However, ethnomathematics continues to be an important field of study, as it provides a valuable counterpoint to the Eurocentric view of mathematics (Borba, 1990; Rowlands & Carson, 2002).

Mathematics Storytelling

In a culturally diverse classroom, it is important to provide opportunities for each student to share their voice (Limin, 2012). This can be done in the form of storytelling, connecting mathematics with the everyday life experiences (Chao et al., 2021; Niemi et al., 2018; Niemi & Niu, 2021; Özpinar et al., 2017; Starčič et al., 2016; Walters et al., 2018). Providing student voice opportunities helps us to see the mathematics education landscape from a variety of different perspectives, and identify areas that need improvement. Through stories, we can come to a deeper understanding of the personal feelings (Connelly & Clandinin, 1994) that each student has to mathematics, and build relationship with dialogue (Aubert & Soler, 2007; Clandinin & Connelly, 1998; Gómez et al., 2011; San Pedro & Kinloch, 2017b; Sfard & Prusak, 2005). This understanding is essential in creating an inclusive classroom "environment that minimizes any stress resulting from any discrepancy in cultural norms" (Limin, 2012).

Mathematical stories provide students with an opportunity to engage with the mathematical content in a creative way. In order to make the most of this opportunity, it is important for students to provide feedback to each other during the story-making process (Chao et al., 2021; Lambert, 2013). This dialogue gives students a chance to reflect on what is working well and identify areas for improvement. Once the stories are complete, educators should invite community members to come and experience them (Chao et al., 2021; Lambert, 2013). This provides an opportunity for members of the community to see the mathematical learning that is taking place and feel connected to it. It also allows them to share their perspectives, which can further enrich the students' learning.
Innovation and Potential Projects

A recent systematic review revealed that out of 1,063 literature pieces centered around educational digital storytelling (Wu & Chen, 2020), only one surveyed the use of this method with English as a Second Language (ESL) initiatives in Indonesia (Afrilyasanti & Basthomi, 2011). While digital storytelling has been identified as an effective medium for enhancing learning experiences, it is clear from these results that there is still room for growth in terms of its application to mathematics. Moreover, many ethnomathematics studies in Indonesia (Budiarto et al., 2019; Fathikhin & Wijayanti, 2020; Fredy et al., 2020; Kusuma et al., 2017; Pathuddin & Nawawi, 2021; Prahmana & D'Ambrosio, 2020; Risdiyanti & Prahmana, 2018; Ulum et al., 2018; Wardani et al., 2018) lack employing a transformative approach to help marginalized students from other cultural backgrounds. Furthermore, none of the ethnomathematics research has connection to storytelling or fund of knowledge frameworks, both of which hold potential for maximizing the connection between mathematics and culture to grow understanding of students' experiences.

Within Indonesia, there is an incredible diversity of cultural backgrounds making a cultural approach to teaching mathematics essential for success. With many ethnic groups represented among the citizens of Indonesia, a culturally sensitive teaching style can ensure that all students are able to benefit from their education. More research that holistically combines mathematics, storytelling and ethnomathematics as well as community funds of knowledge must be conducted in order to properly maximize the potential of students in nations with a rich heritage of multiple cultures.

CONCLUSION

In summary, with the diverse culture that Indonesia has necessitates an expansive approach to education which includes multiculturalism. This provides us a perspective that cultural differences are an asset, not deficit. As such, students of all backgrounds are provided a platform for expression and learning. Although it has faced some criticism, there are numerous strategies one can draw on for implementation to prevent oppression faced by students in schools and classrooms.

The diversity of culture that Indonesia has also impacts mathematics education. The traditional view is that mathematical disciplines are not bound by culture, however, this notion is plainly contradicted by the reality that various cultures do have an influence on mathematics itself. To embrace all students from diverse cultural backgrounds, educators must broaden their instructional methods beyond those strictly Eurocentric perspectives. Strategies such as embracing community funds of knowledge, practicing ethnomathematics and incorporating mathematics storytelling can help provide an educational landscape that emphasizes succeeding together through diversity.

Research that investigates the combination of mathematics storytelling, ethnomathematics, and community funds of knowledge to maximize the potential of students in diverse countries, such as Indonesia, is becoming increasingly necessary. Such initiatives need to encompass a wide spectrum of applicable approaches to ensure that students are encouraged and enabled to unlock increased learning opportunities relevant to the cultures within which they live.

DECLARATION

Author Contribution : The author takes all responsibilities of the paper
Funding Statement : -
Conflict of Interest : The authors declare no conflict of interest.
Additional Information : Additional information is available for this paper.

REFERENCES


Copyright © 2023; Author(s); 2339-224X (print) | 2579-3209 (online)


Copyright © 2023; Author(s); 2339-224X (print) | 2579-3209 (online)