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Research on Sociocultural Aspect of Mathematics Curriculum Development: A Case of Mozambique National Curriculum

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Abbreviation

CCSS	Common Core State standard
DeSeCo	Definition and Selection of Competencies: Theoretical and Conceptual Foundations
ESM	Educational Studies in Mathematics
EFA	Education for All
ERIC	Education Resource Information Center
ESM	Educational Studies in Mathematics
IBE	International Bureau of Education
IEA	The International Association for the Evaluation of Education Achievement
INDE	Instituto Nacional do Desenvolvimento da Educação
JICA	Japan International Cooperation Agency
JRME	Journal for Research in Mathematics Education
MFA	Mathematics for All
MINED	A Ministra da Educação e Desenvolvimento Humano
NCTM	National Council of Teachers of Mathematics
OIF	L'Organization Internationale de la Francophonie
OECD	Organisation for Economic Co-operation and Development
PISA	Programme for International Student Assessment
SACMEQ	Southern Africa Consortium for Monitoring Educational Quality
SDGs	Sustainable Development Goals
SSCI	Social Science Citation Index
TIMSS	Trends in International Mathematics and Science Study
UN	United Nations
UNESCO	United Nations Educational, Scientific and Cultural Organization

CHAPTER 1
INTRODUCTION

Chapter 1 clarifies the background and objectives of this study. Section 1 outlines the areas that this study focuses on from both academic and practical perspectives, namely curriculum development in developing countries. Section 2 describes the research objectives and questions. Section 3 explains the significance of this study. Section 4 presents the structure of the study.

1.1 Background of the study

(1) Academic perspectives on the sociocultural aspect of mathematics education

Universality was an unshakable premise in mathematics education based on the universality of mathematics in a foundational and central notion (Bruner, 1973). His idea which is called structuralism became the basic philosophy of the new mathematics movement in the 1960s (Steffe & Kieren, 1994). After the Sputnik crisis of 1957, the development of mathematics curriculum made progress between the 1960s and 1970s. Curriculum developers thought that the mathematical structures were obtained through logical and conceptual processes. Set theories and topologies were incorporated into the curriculum and teaching materials from an early stage （Hayden, 1981). However, the educational approach, which sought an excessive degree of scientific rationality and rigor, became detached from the realities of the classroom. Thus, the developments were generally considered a failure (Walmsley, 2003). “Mathematics for All” (MFA) was formed as a thematic group at the Fifth International Congress on Mathematical Education in 1984. The report of MFA made a case for the reconsideration of mathematics education from the social and cultural aspect, such as those pertaining to ethnic minorities, different gender identities, and developing countries (Damerow et al., 1984). People began to discuss who should be targeted, the different kinds of mathematics, and how the subject should be taught. This meant reconsidering the universality of mathematics and the assumptions that mathematics education had relied on until then. That year, “ethnomathematics,” proposed by D’Ambrosio (1984, 1985), highlighted the existence of different kinds of mathematics in various culture. These studies highlighted the existence of various learners and different types of mathematics in mathematics education. Bishop (1991) proposed capturing the entire picture of mathematics education in five levels, namely cultural, societal, institutional, pedagogical,

and individual levels. At the cultural level, mathematics is seen as a cultural phenomenon that is supra-societal. The societal level implies that mathematics is mediated by various institutions in society and subject to the political and ideological forces at play in each society. In addition, he identified six universal activities: counting, locating, measuring, designing, playing, and explaining. His proposal is unique in that these activities are inherent in every culture, although they sometimes appear in different ways. This allows us to see alternative mathematics in each society. Thus, mathematics education came to be captured holistically. “Culture” and “society” significantly influenced activities in schools.

Since the 1980s, research on specific social and cultural components such as language, gender, and so on, has been actively conducted. According to many researchers, these components constitute the “sociocultural aspect” (e.g., Atweh et al., 2001). However, there is no fixed concept of the sociocultural aspect of mathematics education and the research in this area has varied significantly (Seah et al., 2008). Therefore, it is difficult to discuss various studies in the same way. In addition, Khoon et al. (2010) pointed out that although individual components have been examined in depth, the importance of a systematic and comprehensive view of these components must also be emphasized.

The rapid globalization of society since the latter half of the 1990s has led to the implementation of various international large-scale assessments such as Trends in International Mathematics and Science Study (TIMSS) and Programme for International Student Assessment (PISA) to improve the quality of education. These surveys have placed education, which was originally considered diverse and incomparable, in a homogenized measurement space and reconfigured it as a comparable entity (Takayama, 2018). The quality of education considered sociocultural aspect is not always the same as the situation of economic development. As a result, criticism was raised that countries with completely different situations were being evaluated using the same standards, and that international large-scale assessments distort the mathematics curriculum of many countries. This is because the peculiarities embedded in an individual country by their race or culture, which initially seem inconsistent with the universality of mathematics, must be dealt with in mathematics education (Kusaka, 2019). The sociocultural aspect of mathematics education is difficult but necessary to deal with by finding a way to reconcile universality and cultural specificities.

(2) Challenges in developing mathematics curriculum in developing countries

From the 1950s to 1970s, many African countries gained independence from their former colonial rulers. Curriculum development in both the colonial era and post-independence period were either explicitly based on the curriculum of the colonizing countries, or cleverly revised to perpetuate colonial rule. These curricula did not consider the sociocultural aspect of the African countries (D'Ambrosio, 1984). After independence, the starting point for decolonization in education was the revision of the public education curriculum (Lebeloane, 2018). MFA was set up as a thematic group at the International Congress on Mathematical Education (ICME) 5 in 1984, and discussions on mathematics curriculum began to take place in developing countries (Damerow et al., 1984). Gerdes (1986) delivered a scathing criticism of the terrible trends in mathematics education in developing countries caused by the hasty transplantation of curriculum from highly industrialized capitalist nations to third-world countries. Nebres (1988) indicated that a uniform mathematics curriculum does not fully reflect the unique needs of a country and its sociocultural situation. In many cases, developing countries borrow curricula framed for the elite in developed countries. Joseph Ki-Zerbo pointed out that post-independence Africa was still sleeping in "somebody else's mats (p.23)," arguing that African countries must be liberated from these circumstances (Ki-Zerbo, 1992). The words *somebody else's mat* can be seen to encapsulate the problem of importing curriculum in mathematics education.

Jacobsen (1996) noted that in the late 1990s, attempts to reform mathematics education by copying overseas reforms posed a real threat, as many developing nations did not have the resources to develop their own educational curriculum amidst their problems and priorities. Various countries and educational donors have begun supporting curriculum development in developing countries. If cooperation is implemented only because of its advantage in mathematics and science education without any additional discussion and clarification of the sociocultural aspect, there is a risk of repeating the past experience of transplanting the curriculum of developed countries into developing countries.

Since the 2000s, the 21st-century skills and key competencies originated in economically advanced countries, such as by the OECD, have been influencing both developed and developing countries. As a result, as indicated in the 2015 Education for All (EFA) summary, the quality of education in developing countries has hardly improved and remains low. Improvement in the quality of education is an objective of both Education 2030 and Goal 4 of the UN Sustainable Development Goals (SDGs) (United Nations, 2015), which highlights the importance of revising curricula to take into account the appreciation

of cultural diversity as a necessary value to be nurtured in children. For different reasons at different times, developing countries have not been able to develop mathematics curricula by taking into account their own state of affairs. In recent years, this situation has become more and more complex because of the effects of globalization.

To sum up, the sociocultural aspect of mathematics education outlined in (1) is closely linked to issues in the development of mathematics curriculum in developing countries. Based on reflections on the New Mathematics Movement and post-modern trend, various studies were conducted related to on the sociocultural aspect of the subject, such as the diversity in mathematics education and specificity of each society and learner. However, the term "sociocultural aspect" has not been clearly defined, and its meaning in each study is unclear, which has made it difficult to discuss them at the same level. Globalization has progressed rapidly since the late 1990s, and has made the sociocultural aspect of mathematics education more complex and equipped it with new perspectives. Therefore, it is difficult to advance the discussion on the sociocultural aspect of mathematics education without defining it and take a holistic view of the relationships between components that constitute it. In addition, concerning the actual mathematics curriculum development, especially in developing countries, mathematics curriculum of developed countries has been imported without any criticism.

1.2 Research objectives and questions

Based on the background presented in the previous section, this study has two objectives:

1. Identify a framework and methodology for analyzing the sociocultural aspect of mathematics curriculum development.
2. Analyze the characteristics of the sociocultural aspect of Mozambique's national mathematics curriculum development based on the framework.

The following research questions are addressed to achieve the objectives of this study:

(i) What is the sociocultural aspect of mathematics curriculum development? What are its major components? (Chapter 2)

(ii) How is the sociocultural aspect pf mathematics curriculum development analyzed? (Chapter 3)

(iii) What is the status of Mozambique's mathematics curriculum development? (Chapter 4)

(iv) What are the characteristics of Mozambique's mathematics curriculum development

with reference to global discourse? (Chapter 5)

1.3 Research approach

This section describes the approach taken to answer the research questions and achieve the research objectives. The research questions are answered through a theoretical analysis of the sociocultural aspect of mathematics curriculum and an empirical analysis of Mozambique's mathematics curriculum development process.

1.3.1 Terminology

The key terminologies used in this study are clarified here. First, the *sociocultural aspect*, which is the main focus of this study, comprises various components. It is called *aspect* in its singular form. Items that constitute the sociocultural aspect are known as *components*. Second, concerning the terms, global and international, Baba and Gonzales (2016) stated that international emphasizes cultural diversity whereas global emphasizes universality. The former assumes nationalities and borders and considers relationships with other countries while remaining aware of one's own country. Global is the universality of everything beyond the framework of a country. In a world with increasing globalization, it means that even if there are borders, ideas are easily spread across them. In this study, the term *global* is always used when comparing Mozambique's discourse to discourses such as global discourse. On the other hand, the term *international* is only used to define fixed names, such as international organizations or international large-scale assessments. Third, *mathematics education* is replaced by *mathematics curriculum* in this study, as *curriculum* indicates the holistic view of mathematics education, right from the intended to the attained curriculum. Finally, concerning *mathematics curriculum development*, this study deals with on only the intended curriculum. Therefore, it means the mathematics curriculum development of the intended curriculum comprises both the mathematics curriculum (product) and its development process (process).

1.3.2 Rationale for selecting Mozambique as a case study

This section describes the reasons for selecting Mozambique as a target country for analysis from two perspectives: generality and specificity.

(1) Generality of historical changes in the mathematical curriculum

During the Portuguese colonial period, the Portuguese primary mathematics curriculum was used as it is in the African country. Three revisions (1984, 2004 and 2015) have been made

since independence in 1975. In the 2004 revision, adapting to the needs of the region was considered as one of the main objectives. The results of the Southeast Africa Regional Assessment for Primary Education (SACMEQ) survey had a significant impact on the 2015 revision. It can be said that Mozambique is a typical country in that the nation used the colonial curriculum before independence and has revised it thrice since independence in accordance with the curriculum trends in each era. Although the official language is Portuguese, it is a multilingual nation, with more than 20 Bantu languages spoken daily. This language complexity is similar to other African countries in that each tribe has its own language.

(2) Specificities of the cultural background

The culture of Mozambique was mixed and diverse even before the Portugal rule because they had developed as a trading base with the Arabs, India, Persia, and China. It is expected that further globalization will happen with the development of countries and regions. These cultural aspects seem unique to Mozambique and are not evident in other African countries.

From the above discussion, it can be seen that Mozambique has commonalities with other African countries, while also having peculiarities that are not evident in other African countries. The results and analysis can have implications for other countries. Therefore, the author judged that Mozambique is suitable for the analysis in this study.

The author participated in JICA's Project for Expansion of the New Curriculum of the Teacher Training Institute (IFP) in Mozambique from April 2016 to March 2020. He visited Mozambique every three month and worked in Ministry of Education and Human Development (MINED) during the project. This experience has provided him the basis for a deeper understanding of mathematics education in Mozambique. In addition, it also allowed him to analyze the Mozambican curriculum development process objectively as an external researcher.

1.3.3 Approaches to the research questions

(1) Definition of the sociocultural aspect of mathematics curriculum and selection of sociocultural components (research question (1), explained in Chapter 2)

What is the sociocultural aspect of mathematics curriculum development? The author discusses the fundamental questions in this study and draws on previous studies, specifically

Bishop (1991) and Khoon et al. (2010) to define the sociocultural aspect. A meta-analysis of previous studies is conducted, and major components that constitute the sociocultural aspect are extracted. Relying on Baba's (2019) framework for capturing the sociocultural aspect from the purpose, content, and method, the extracted components are analyzed with due consideration for their inter-relationships. Finally, the status of global discourses on the sociocultural aspect is examined by drawing from discussions held at international organizations on each component.

(2) Development of the methodology for analyzing the intended mathematics curriculum with due regard for the sociocultural aspect (research question [ii], explained in Chapter 3)

The methodology of analyzing curriculum development which relates to research question (ii), is a key outcome of this study. It is presented in Chapter 3. To consider the sociocultural aspect of mathematics curriculum development, it is necessary to analyze both the product of the developed curriculum (product), but also the process of development and revision (process). It is crucial to develop methodologies to analyze both to reveal the sociocultural aspect of the mathematics curriculum.

(3) Analysis of Mozambique's primary mathematics curriculum development (research question (iii), explained in Chapter 4)

The author analyzes Mozambique's intended mathematics curriculum, with a focus on both the revised content (product) and the revision process (process) based on the defined sociocultural aspect and components evaluated in this study. First, the author analyzes the three curricula adopted since Mozambique's independence (1984, 2004, and 2015) in accordance with the established analytical framework, and discusses the results from the perspective of the sociocultural aspect. The author highlights the changes made by each revision. In terms of the curriculum development process, focusing on the 2015 curriculum revision, the author analyzes the revision process based on what is discussed in the curriculum revision and the materials used.

(4) Analysis of the sociocultural aspect of mathematics curriculum development in Mozambique (research question (iv), explained in Chapter 5)

The sociocultural aspect of the mathematics curriculum development of Mozambique is examined in light of global discourses as most discourses on education are spearheaded

by international organizations and OECD member countries. Developing countries simply imitate them without considering the sociocultural aspect. We can get clues on the sociocultural aspect of mathematics curriculum development in Mozambique by focusing on the points of difference from global trends.

1.4 Significance of the study

The significance of the study is described by highlighting the research gaps in the extant literature.

(1) The need to define the sociocultural aspect, and extract and capture its components holistically

As mathematics is a universal discipline, it was originally assumed that it is not affected by social and cultural influences. However, since the 1980s, the sociocultural aspect was understood to play a major role in mathematics as a school subject. Two studies were found to have taken a comprehensive view of the sociocultural aspect of mathematics curriculum, after reviewing three well-known handbooks in this area, namely "Critical Issues in Mathematics Education: Major Contributions of Alan Bishop" (Clarkson & Presmeg, 2008), which presents the significant contributions of Professor Alan Bishop in the field of mathematics education research; "Sociocultural Research on Mathematics Education" (Atweh et al., 2010) which summarizes major studies on the sociocultural aspect of mathematics education; and "Third International Handbook of Mathematics Education" (Clements et al., 2013) which summarizes the major studies on all aspects of mathematics education. The gap in research is explained by drawing on these three books.

Table 1 presents the relationship between previous studies and this study. Bishop (1991) proposed capturing mathematics curriculum at five levels, namely the cultural, societal, institutional, pedagogical, and individual levels. In his study, all five levels are considered part of the mathematics curriculum. He explained that the "cultural" and "societal" levels form the bases of the "institutional," "pedagogical," and "individual" levels. Thus, he proposed that the "cultural" and "societal" levels are also part of the curriculum by showing the hierarchy of the curriculum. However, he only addressed the relationships among the levels. Khoon et al. (2010) observed the cultural and social aspect through a planar view and described related components such as history, culture, politics, and events in the classroom. Drawing from these two previous studies, this study goes further into the components that constitute the sociocultural aspect, and develops a framework to capture an integrated view of the relationships among them. The reason why it is necessary to capture the concrete

components holistically is that sociocultural aspect of the mathematics curriculum has become more complex under the influence of rapid globalization. To reveal the state of the sociocultural aspect of a national mathematics curriculum in detail, it is essential to capture and discuss individual components holistically by considering the relationships among them. The results highlight specific components and their relationships with the cultural and societal levels in the five levels of mathematics education identified by Bishop (1991). Furthermore, the results are expected to lead to the pedagogical (implemented curriculum) and individual (attained curriculum) levels.

Table 1. Relationship between previous studies and this study

	Bishop (1991)	Khoon et al. (2010)	This study
Subject	➢ Captured mathematics education at five levels: cultural, societal, institutional, pedagogical, and individual levels.	➢ Captured the cultural and social levels through a planar view and described the relationship with related content such as history and culture. ➢ Used the sociocultural aspect as a lens to analyze the mathematics curriculum from outside.	➢ Goes further into the specific components that constitute the sociocultural aspect, and develops a framework to capture an integrated view of their relationships. ➢ Develops a methodology of analyzing mathematics curriculum development, which captures the sociocultural aspect from outside and inside. (Practical contribution) ※ The methodology and framework can serve as a basic resource for the discussion of a country's specific situation and needs.
Outcomes and Limitations	✓ Showed that various levels are related to mathematics education, and that culture and society influence mathematics education. ✓ Limited to the levels in a hierarchy.	✓ Showed the relationship between the influential and affected sides across different levels. ✓ Analyzed only the sociocultural aspect, that influences mathematics education. ✓ Still limited to history and culture and so on, which has a broader meaning.	

Source: Developed by the author

(2) Mathematics curriculum development in developing countries

This study focuses on mathematics curriculum development of intended curriculum. Developing countries have either adopted the curricula of developed countries as they are, or have borrowed curricula and made superficial modifications. This is why the targets and indicators of SDG 4 state that curricula must take into account cultural diversity and the contribution of culture (UNESCO, 2015b). There have been many approaches toward the development of curricula by drawing a comparison of the curricula used in developed countries. However, few studies have approached the curriculum development process (process) in itself. As mentioned earlier, curriculum development comprises both the curriculum (product) and the curriculum development process (process). It is necessary to clarify the sociocultural aspect of both the product and process. Although academic research has been conducted on the sociocultural aspect, there has been no framework for the analysis of how the sociocultural aspect is considered in the actual practice of mathematics curriculum development. Without an approach to curriculum development, the fundamental problem of curriculum development cannot be resolved, and a true improvement in the quality of education cannot be expected.

This study provides a methodology for examining a mathematics curriculum with a focus on individual components and relationships that constitute the sociocultural aspect. In other words, This study can help address practical issues in developing countries.

1.5 Structure of the dissertation

Table 2 presents a summary of the structure of the dissertation. Chapter 1 presents the background, objective, research approach, and significance of the study. Chapter 2 analyzes mathematics curriculum development and the status of mathematics curricula in developing countries based on the educational borrowing theory. The sociocultural aspect of the mathematics curriculum is defined based on previous research. Major components of the sociocultural aspect of the intended mathematics curriculum are clarified through a meta-analysis of previous studies. Chapter 3 presents a methodology for analyzing the intended mathematics curriculum. Chapter 4 presents an empirical analysis of the changes in the intended mathematics curriculum in Mozambique. The three curricula adopted since Mozambique's independence (1986, 2004, and 2005) are analyzed. The author analyses the 2015 curriculum revision process by focusing on the content and materials relied on in revising the curriculum. Chapter 5 clarifies the characteristics of Mozambique's mathematics curriculum with due reference to global discourses and policies. Chapter 6 summarizes the

findings and the limitations of this study, and offers recommendations for future research.

Table 2. Structure of the dissertation

	Content	Outcomes
Chapter 1	**Introduction** Background Objective Significance and novelty	
Chapter 2	**Literature review** - Mathematics curriculum in developing countries - Definition of the sociocultural aspect of mathematics curriculum - Meta-analysis of the components of the sociocultural aspect - Global discourse	✓ Sociocultural aspect of mathematics curriculum is defined ✓ Major components of the sociocultural aspect are selected by meta-analysis ✓ The conceptual framework of the sociocultural aspect is presented ✓ Summary of global discourses
Chapter 3	**Methodology** - Methodologies for analyzing mathematics curriculum development	✓ Methodology for analyzing mathematics curriculum (Product) and curriculum revision process (Process)
Chapter 4	**Results** **Case study of Mozambique** - Analysis of intended mathematics curriculum (Product) - Analysis of curriculum revision process (Process)	✓ Analysis of the intended mathematics curriculum (1984, 2004, 2015) and revision process (2015)
Chapter 5	**Discussion and conclusion** - Sociocultural aspect of mathematics curriculum development in Mozambique with reference to global discourse	✓ Clarification of the characteristics of sociocultural aspect of mathematics curriculum development in Mozambique.
Chapter 6	**Summary of the study and way forward** - Limitations and recommendations for future research	✓ Limitations and possible directions for future research ✓ Proposal for the development of a mathematics curriculum in developing countries

CHAPTER 2
LITERATURE REVIEW

In defining the problem statement in Chapter 1, the failure to consider the sociocultural aspect while developing mathematics curricula was identified as an issue. This chapter captures the trends in curriculum development in developing countries from the colonial era to recent times based on the educational borrowing theory (Phillips & Ochs, 2003) because the exclusion of the sociocultural aspect of the mathematics curriculum in developing countries ensued from the transplantation of the curricula of developed countries. Second, the sociocultural aspect of mathematics curriculum is discussed and defined. The major components of the sociocultural aspect of mathematics curriculum are determined through a meta-analysis of previous studies. Finally, global discourses are summarized, as they offer a reference point while analyzing the characteristics of curriculum development in Mozambique in Chapter 4.

2.1 Curriculum Development in Developing Countries

The characteristics of the curriculum and curriculum development in developing countries, primarily in Africa, are organized with respect to three periods: the colonial era and period immediately after independence, the period after independence, and the recent period based on two books namely "A History of Education in East Africa" (Ssekamwa & Lugumba, 2001) and "Empire and Education in Africa: The Shaping of a Comparative Perspective" (Kallaway & Rebecca, 2016) and various research articles. This process provides a foundation for considering curriculum development in developing countries in relation to the educational borrowing theory in the sections that follow.

(1) Curricula in the Colonial Period and the period Immediately after Independence

From the 1950s to the 1970s, many African countries gained independence from their former colonial rulers. Colonial rule by Western European powers had brought destruction on all aspects of African life, including traditional political systems and the sociocultural norms and values of indigenous peoples (Aissat & Djafri, 2011). The educational policies advanced by the colonial powers were partly to blame for this. Educational reforms in Africa began with the establishment of mission schools, which were built across the continent from the 19th century onward. Since little had been done with respect to education in many parts

of Africa, the mission schools were run by European missionaries without government interference, primarily for the purpose of religious conversion. Until the end of the 19th century, most African people followed traditional religions and Islam (Basu, 1989). However, from the 20th century onward, Christianity spread rapidly, supplanting traditional African religions. This is one of the most significant cultural transformations in the modern history of the African continent (Sundkler & Steed, 2000). Mission school curricula required children to acquire basic literacy skills in order to read the Bible (Meier zu Selhausen, 2019). Mission schools subsequently became "government schools" as a result of the colonial policies of the European powers. These schools promoted the assimilation of these children into European culture. Awasum (2014) pointed out that children were strategically distanced from offering respect for the values of their local society and prevented as far as possible from noticing changes in their environments. The curricula employed in these schools were the same as those used in the home countries of the colonial powers (Gerdes, 1986). Uchendu (1979) noted that the purpose of all colonial education was the "subordination of Africans," and that curricula from the colonial homelands were adapted for use in the colonies to perpetuate colonial rule. Although students learned mathematics, as their mathematics curricula included advanced content that even the teachers could not understand, mathematics education played an instrumental role in sustaining social inequalities through the exam-based selection system (Isoda, 2007). Ansu (1984, p.6) noted the following:

> Colonial education is characterized by a marked bias toward Europe. This is manifest in curricula and in the languages of instruction. Children were taught in the languages of their colonial masters, and teachers in the French colonies were not permitted to use African languages. Further, students were prohibited, through strict punishments, from expressing themselves in their mother tongues when in school. Similarly, the curricula were highly Eurocentric. In history, geography, literature and cultural study, examples and materials were drawn from European sources. African children in the French colonies learned ad nauseam about the great achievements of 'our ancestors, the Gauls.'. African children in the British colonies battled to memorize obscure British plants and the names of Henry VIII's wives. By emphasizing the Bible in religious education, children were left no room to understand the traditional beliefs and rituals of the African people.

Curriculum development during colonial rule and immediately after independence

comprised either employing the curricula used in the colonial homelands without any change, or cleverly revising them in order to perpetuate colonial rule. There was no consideration for the sociocultural aspect of each African country where the curricula were implemented. With regard to mathematics curriculum, advanced content was deliberately included to divide individuals and maintain inequality in society.

(2) Revision of curricula after independence

From the 1960s onward, many African countries, having gained independence from their colonial rulers, began to decolonize their education systems. It began with the revision of public education curricula (Lebeloane, 2018). The impetus for developing and revising curricula in the international context came from a conference on education held jointly by United Nations Educational, Scientific and Cultural Organization (UNESCO) and the United Nations (UN) Economic Commission of Africa in Addis Ababa in 1961 (Yamada, 2004). Having noted that "the present content of education in Africa is not in line with either existing African conditions, the postulate of political independence but is based on a non-African background," the conference recommended that African educational authorities should reform their curricula, textbooks, and teaching methods. The conference in Addis Ababa urged authorities to take four aspects into account: (1) the African environment, (2) child development, (3) cultural heritage, and (4) adapting to the industrial technology required to achieve economic development (UNESCO, 1961). At this conference, African leaders understood the importance of expanding education and research programs that captured their each country's unique traditions, attitudes, and lifestyles in order to deepen their understanding of African cultural values (Yamada, 2004). For example, Nigeria's Second National Development Plan (1970-1974), established after the post-independence civil war, proposed the objectives of a democratic society, justice, a united nation, and a dynamic economy with equal opportunities for all citizens. It proposed that students should be encouraged to learn about Nigerian culture and the importance of building a united country. In the 1970s, Kenya implemented a policy that sought to integrate education with rural development. Education was designed to prepare students for careers in agriculture, family welfare, and community development in primary schools. Secondary schools were encouraged to promote economic growth, social equality, and respect for Kenya's rich and diverse cultures (Woolman, 2001).

In the context of mathematics education as well, MFA was established at ICME 5 in 1984 as a thematic group, and discussions began on mathematics curricula in developing

countries. The vision of MFA encouraged authorities to reconsider mathematics education from a sociocultural aspect, including situations in and concerning developing countries, ethnic minorities, and gender identities (Damerow et al., 1984). Nebres (1988) noted that as many developing countries had borrowed curricula designed that were meant to educate elites in developed countries, the resulting education failed to reflect the needs and sociocultural circumstances of the countries themselves. Gerdes (1986) was highly critical of this, and asserted that there was a dire trend in mathematics education in developing countries caused by the hasty transplantation of curricula from developed to developing countries. Joseph Ki-Zerbo (1992) pointed out that post-independence Africa was still sleeping in *somebody else's mats* and argued that African countries must be liberated from these circumstances. The words "somebody else's bed" can be seen to encapsulate the problem with importing curricula in mathematics education.

After independence, many African intellectuals were critical of the goals and practices in the education sector in Africa. They thought that the most effective solution for modern education would be to integrate traditional educational values and strengths with the knowledge required to live in a modern world (Woolman, 2001). This criticism focused on the problems of colonial and post-colonial education, the re-investigation of education in traditional Africa, and the pursuit of alternative forms of education that would liberate and develop real African national identities (Woolman, 2001).

However, developing countries faced various issues while revising their curricula, and the revision efforts were considered to have failed to proceed in an ideal direction. In addition, One key reason for this was the power relationships with development donors. Aid donors played dominant and decisive roles in shaping the policy goals of developing countries in the field of education (Samoff, 2005; Tabulawa, 2003; Vavrus, 2003). In addition, the emphasis was on quantitative expansion of education rather than the quality such as conducting curriculum revisions (Sawamura & Sifuna, 2008). Several sub-Saharan African countries implemented curriculum reforms as a means of discharging their accountability to educational development aid donors (Chisholm & Leyendecker, 2008). Many countries were not able to raise adequate budgets for education or revise curricula regularly and systematically because of their dependence on donor budgets to do so. A typical example of this is the remaining influence of the New Math movement on school mathematics. In African countries that were colonies at the time, curricula influenced by this move toward modernization in mathematics education were employed without change, and their influence is still deeply ingrained today. For example, *set theory* was introduced from the beginning

of primary education in a form that is disconnected from children's activities. After independence, countries revised their curricula under the banner of decolonization and Africanization. However, they did not achieve independence when it came to mathematics curriculum development.

In the post-Cold War world, international relations have become truly global (Yilmaz, 2008, p.55) . The EFA was adopted at the 1990 World Conference on Education for All in Thailand. At the conference, it was emphasized that education should play a key role in transforming societies. Large-scale international assessments started around this period. In 1995, the predecessor of the current TIMSS, the Third International Mathematics and Science Study (TIMSS), was conducted at Grade 5 in 44 countries (Martin, 1996). PISA was launched in 2000 with 32 countries. However, as mentioned earlier, the quantitative expansion of education was more focused than curriculum revision to improve the quality of education.

As indicated in the 2015 EFA summary, the quality of education in developing countries has hardly improved and still remains low (UNESCO, 2015a). Improvement is listed as an objective in Education 2030 and SDG 4, which highlight the importance of revising curricula to take the sociocultural aspect of individual countries into account.

(3) Revision of curricula in recent times

A significant trend in curriculum revision in recent times is the influence of frameworks such as *21st century skills* and *key competencies*, led by OECD members and other economically advanced countries, on the educational policies of countries world over. As mentioned when defining the problem statement, Cai and Howson (2013) stated that the trend toward the global unification of mathematics curricula has resulted in great loss. This is not only the case in developed countries. UNESCO has held workshops on competency-based curriculum development in many African countries and many have adopted competency-based curricula (UNESCO & IBE, 2013, 2015). L'Organisation Internationale de la Francophonie (OIF) funds projects related to competency-based curriculum development in 23 Francophone African countries (Bernard et al, 2007). The East African Community has established the East African Community Harmonized Curriculum Structures and Framework, proposing key competencies to be developed through school education based on the notion that school education should build citizens under a common vision to enable the efficient transfer of education, economic resources, labor, and services among partner states (East African Community, 2014). The years in which recent curriculum

revisions were conducted in 21st century in sub-Saharan African countries are presented in Table 3. Many African countries are said to have adopted competency-based systems in curriculum revisions. These new curricula are, at least in name, *competency-based*, but the details of the actual curriculum must be scrutinized regarding the meaning of competency.

Table 3. Recent curriculum reforms in sub-Saharan African countries

Country	Year	Main Reforms
Angola	2005	Outcome-based approach
Benin	2014	Competency-based approach
Burundi	2004	Objectives-driven pedagogy
Cameroon	2013	Competency-based approach
DRC	2002	Whole-person development
Ethiopia	2009	Competency-based approach
Gabon	2013	Competency-based approach
Ghana	2014	Life skills
Kenya	2016	Competency-based approach
Lesotho	2009	Curriculum and assessment policy
Madagascar	2008	Competency-based approach
Malawi	2017	New secondary school curriculum
Mali	2011	Competency-based approach
Mauritania	2007	Competency-based approach
Mauritius	2007	Competency-based approach
Mozambique	2003	Competency-based approach
Namibia	2015	Revised curriculum for basic education
Nigeria	2011	Trade subjects
Rwanda	2012	Competence-based, entrepreneurship education
Senegal	2005	Competency-based approach
South Africa	2011	Outcome-based education
South Sudan	2018	Competency-based approach
Swaziland	2010	Competency-based approach
Tanzania	2005	Competency-based curriculum
Uganda	2006	Thematic curriculum
Zambia	2013	Outcome-based curriculum
Zimbabwe	2006	Two-pathway education

Source: Modified from Fleisch, B., Gultig, J., Allais, S., & Maringe. (2019, p.8)

The categories of qualities and abilities such as competencies to be developed resemble X-ray images that provide only a skeleton of the characterization of specific economic actors and citizens sought by governments, while differences regarding the ideal society and citizens are abstracted as characteristics and organized as “common denominators” in neutral, psychologized language (Ishii, 2017). From the perspective of educational policy, Nishimura (2012) noted the disconnect between the macro-level perspective and micro-level

circumstances, stating that macro-level policies like EFA are among international goals but that only the members of each society can imbue them with meaning. Nishimura emphasized the need to pay attention to the indicators and guidelines used to measure the achievement of this goal and what it means to the members of society. Thus, rather than applying a global discourse and established benchmarks directly, it is important for the local people to internalize them in a manner that is suited to the countries and regions in which they live. Baba (2014) pointed out that although organizations like universities, teacher training colleges, and curriculum development bodies exist in many developing countries, there are very few opportunities for continuous theoretical and practical learning, such as academic conferences, research groups, and classroom observation, which result in a weak foundation of expertise. He asserted the importance of encouraging specialist organizations that embodying the key issues of a given country in order to embrace the awareness of the issues, rather than just giving them with answers (Baba, 2014). However, the new aid paradigm in actual educational cooperation has been criticized for being restrictive in that recipient governments have adopted policies that conform to donors' aims to "maximize ownership in the context of conditionality" (Fraser and Whitfield, 2009, p.93).

It is important for the people of each country to develop their country's mathematics education based on their knowledge and experience, or to independently adopt knowledge and skills from aid organizations, donor countries or international organizations and internalize such knowledge to the domestic sociocultural context.

Thus, from the colonial era to the present, countries have been unable to develop mathematics curricula in ways that take domestic sociocultural aspect into account, mainly because of the lack of specialists in mathematics education who can engage in curriculum development and revision while bearing these aspects in mind. However, there are few mathematics education specialists who can do this, which makes it difficult to revise curricula in a manner befitting the sociocultural circumstances of the country. The next section considers factors that influence mathematics curriculum development and revision in order to build a foundation for the analysis of the sociocultural aspect of mathematics curricula in Chapter 3.

2.2 Policy borrowing in education

"Educational borrowing" is a process whereby a country incorporates the content of the curricula of other countries into its own by "borrowing," "copying," "following," "importing," and/or "occupying" and by comparing the educational experience of other

countries with its own (Okihara & Ozawa 1991; Kitamura 2005; Phillips 2009; Steiner-Khamsi, 2016). The four stages of educational borrowing represent the stages that a country's policies and practices are transferred and internalized to the country that borrowed them. Phillips & Ochs (2004) also pointed out that each of these stages can be categorised from compulsory to voluntary, depending on the initiative of the country that borrowed, using the "spectrum of educational transfer". Phillips and Ochs (2004) insisted that there are ranges from compulsory to voluntary in the policy borrowing based on the borrowing country's initiative, and suggested them as "spectrum of educational transfer."

The main problem with the transplantation of mathematics curricula from developed countries is that the sociocultural aspect of the country engaging in such transplantation is not considered. The educational borrowing theory is closely related to the focus of this study to analyze the aforementioned history of curriculum development in developing countries. This section offers theoretical perspectives on educational borrowing and the spectrum of educational transfer.

(1) Four stages of educational borrowing

Phillips and Ochs (2003) hypothesized that there are four stages in the process of gaining interest in and adopting the educational curricula of other countries (Figure 2). In the first stage, "cross-national attraction," educational policies and methodologies are sought from outside the home country because of internal dissatisfaction, institutional disruption of education, negative external evaluations, and policy shifts. In the second stage, "decision," the country decides on the way in which it will incorporate the educational components of other countries. They sub-divided this stage into four sub-stages. The first is "theoretical decision," which refers to the action of determining the necessary components and borrowing them only if the policy of the borrowing country is different from the objectives of the lending country. Therefore, new educational systems and methods created by theoretical decisions may not be the same as those in the country that lent them. The second is a "phony decision." This occurs, for example, when a Minister of Education decides to borrow the excellent components of a curriculum from other countries. The educational systems or methods so introduced may not work at all because they do not take into account the context of the borrowing country. The third is "realistic/practical decision," which refers to the decision to borrow a whole educational component from a country. This seems difficult to implement unless its validity is sufficiently proven. The fourth is a "quick fix decision," which is very dangerous because it is not based on the results of research that has

scientifically considered the validity of borrowing educational components. Even if it is only partial borrowing, it is different from "theoretical decision" in that its purpose is not discussed. The third stage is "implementation" and refers to the process of adapting the borrowed educational elements to suit home country system. The time required for this step is closely related to the stakeholders' support for the content to be adapted and the budget available. The final stage is "internalization," where the transferred educational policy is institutionalized. It comprises four continuous steps: 1. Impacting the existing system, 2. Absorption of external features, 3. Synthesis, and 4. Evaluation. Carnoy and Rhoten (2002) pointed out that in the third step, "synthesis," the national context or society affects the interpretation and implementation of borrowed policies, which are contextualized again in the country or society.

Ono (2018) pointed out that Phillips and Ochs relied on historical cases that had already completed the four stages of transfer to construct the theory. She noted that the cases analyzed were limited to the European context. In other words, educationally advanced countries like the US and European nations conducted educational transfer through these four steps without skipping any step. Therefore, it was considered an ideal model for educational transfer. However, in developing countries, it seems that some of the four stages of educational transfer are not fully discussed or have been entirely excluded because of the lack of professional organizations and specialists. This may explain why unsuccessful curriculum revisions were cited as the reason for the lack of improvement in the quality of education in the MDGs, and curriculum revision was considered important in the SDGs and Education 2030.

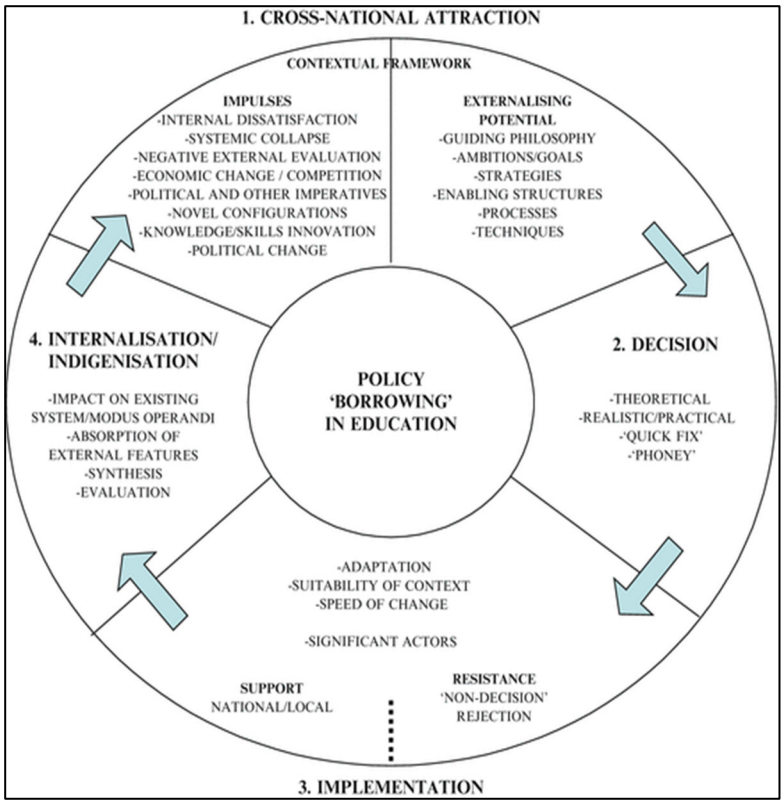


Figure 1. Four stages of educational borrowing (Phillips & Ochs, 2003, p.452)

(2) Spectrum of educational transfer

"Spectrum" refers to a range or distribution of things. Phillips and Ochs (2004) suggested that educational transfer is categorized in a continuum ranging from compulsory to voluntary, based on the borrowing country's initiative (Figure 2). To the left of the spectrum is "compulsory," which indicates an educational transfer that is a result of totalitarianism or authoritarianism. According to Phillips and Ochs (2004), for example, during the British colonial era, the educational systems in the Caribbean, African, and Asian colonies were based on the British approach, and were compulsorily and closely related to the needs of the British economy. After World War II, the victorious countries sought the introduction of new measures into Japan and Germany. They came under category "2" (required under certain constraints). In the case of "3," policies and practices must be changed in return for various types of aid. Cases of intentional and voluntary borrowing are categorized as "4" (Ono, 2018). Finally, category "5" on the right refers to a situation that enables the adaption to local conditions. Thus, educational transfer tends to be at the "voluntary" end of the continuum. The four stages of educational borrowing mentioned in the previous section were conducted in educationally advanced European nations and the US. Therefore, all stages tended to be in category "4" or "5" on the spectrum. It is possible

to determine the extent to which the intended mathematics curriculum takes into account the sociocultural aspect of the concerned country by examining the level at which educational transfer takes place according to this spectrum. This explains why the sociocultural aspect of curricula was emphasized in the SDGs and Education 2030.

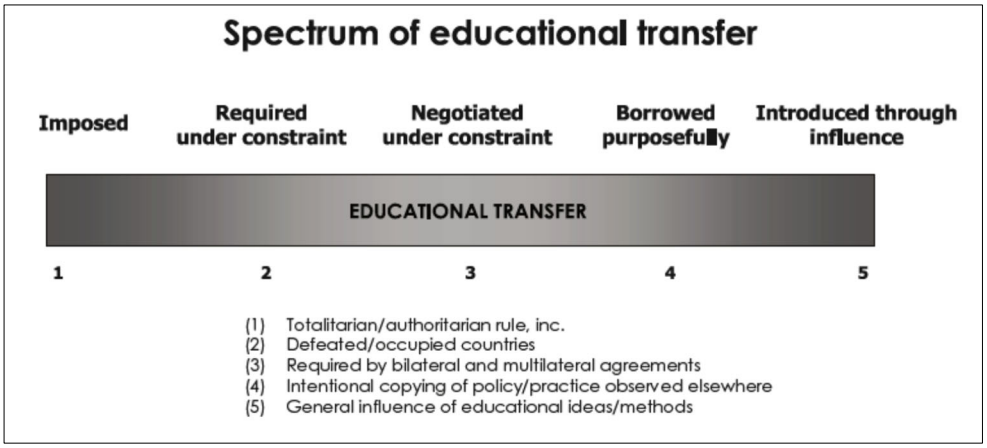


Figure 2. Spectrum of educational transfer
(Source: Phillips & Ochs, 2004, p. 9)

2.3 The relationship between curriculum development in developing countries and educational borrowing theory

In this section, the history of curriculum development in Africa, outlined in 2.1, is considered and discussed based on the educational borrowing theory outlined in 2.2 by looking at the historical transitions that yielded the current state and challenges in curriculum development in developing countries.

(1) Historical transition of the educational borrowing theory in mathematics curriculum development

Table 4 summarizes the discussions according to the timeline, while taking into account the factors in curriculum development and relevance of curricula based on the four stages of educational borrowing and the spectrum of educational transfer. The Bible was initially used to spread Christianity in mission schools in colonies. In the colonial era and immediately after independence, the curricula of former colonial powers were used as they were. Therefore, even the first stage of educational borrowing had not started yet. As the curriculum of another country was imposed without any modifications, this stage corresponds to “1. Imposed.” Here, the social relevance, that is, the fact that the teaching

content should be related to societal issues, was hardly taken into account. As political control of the former colonial powers was strong, political relevance played a significant role.

Since the 1990s, many sub-Saharan African countries implemented curriculum revisions. However, they copied the curricula of developed countries because they did not have experts who could accurately capture and discuss the educational situation and because there were insufficient domestic data on education. There were situations where aid donors played an overpowering role and recipient countries had to comply (Chisholm & Leyendecker, 2008). While applying the four stages of the educational borrowing model to these situations, it seems that the countries were in the "phony" or "quick fix" phase in the second stage, namely "decision." In the spectrum of educational transfer, they fell under "2. Required under constraints" or "3. Negotiated under constraints (Phillips & Ochs, 2004, p. 9)."

With a quantitative expansion of education, developing countries have begun to establish educational systems since 2000. Some countries began implementing curriculum revisions based on their own accumulated data and experience in education. This corresponds to the third stage in the educational borrowing model, namely "implementation." They also tried to promote "internalization," which is the fourth stage. On the other hand, international large-scale assessments such as TIMSS, PISA, and SAQMEQ had a strong impact on curriculum revisions. As these academic surveys were developed based on the ideal image of human beings and the ideal academic level that students should acquire, they prompted nations world over to achieve the same objectives. Discussions on the new academic aspect, such as a competency-based curriculum are being conducted mainly by developed countries with economic power. Developing countries are revising their curricula in line with such global trends. Following this, they proceed to the fourth stage, that is, "internalization," where the transferred educational policy is institutionalized in the country. However, the problem here is that it is difficult for a country to internalize a borrowed curriculum to suit its domestic situation. If the borrowed curriculum is not adapted and internalized in accordance with the educational situation in the country, it will not function effectively and the quality of education will not improve. For effective internalization, subject matter expertise should be fostered and domestic educational data must be accumulated. For the system to function in a well-balanced manner, it is necessary to have bureaucratic control, where education is governed by administrative power; professional control, where educational researchers and teachers are entrusted with decision-making

power; and residential control in cooperation with local communities and the market. Those controls must function from the “cross-national attraction” (first) stage rather than from the “internalization” (fourth) stage.

Table 4. Characteristics of curriculum development in developing countries

	Characteristics of curricula	Educational borrowing theory	
		Four stages of educational borrowing.	Spectrum of educational transfer.
Colonial Period and the Immediate Post-Independence Period	In most cases, the curricula of former colonial powers were used as they were.	As there was no discussion on educational borrowing, it did not fit into the four stages of educational borrowing.	This corresponded to stage "1. Imposed" as the curricula of the former colonial powers were imposed as they were and there was no space for debate.
Revision of curricula after independence	・There was a real danger in attempting to reform mathematics education by copying overseas reform as many developing nations did not have the resources to develop their own educational curricula considering their own problems and priorities (Jacobsen, 1996). ・Aid donors played an overwhelming and decisive role in educational policy-making (Samoff, 2005) ・Many sub-Saharan African countries continuously implemented curriculum reforms to fulfill their accountability to educational development assistance donors (Chisholm & Leyendecker, 2008).	・This corresponded to the second stage (Decision), particularly "Phony," "Realistic/Practical," or "Quick Fix" Decisions. ・Proceeding from the third stage (Implementation), it was difficult to conduct the fourth stage of "Internalization" because it was not suitable for the country or region.	This corresponded to "2. Required under constraints" or "3. Negotiated under constraints" because of the lack of resources and/or power balance with aid donors although discussions on educational borrowing took place.
Revision of Curricula in Recent Times	・The mathematics curriculum is in danger of being circumscribed because of TIMSS and PISA (Cai & Howson, 2013). ・Competency-based curriculum reforms are underway world over, but the content is similar in all countries. ・African countries create their own textbooks to meet their own needs (Fredriksen & Brar, 2015). ・Curricula have been revised, but classroom lessons have not changed (Kusaka, 2019).	・The situation is different from the 1990s and 2000s because of additional factors such as international large-scale assessment and globalization. However, this corresponds to the second stage (Decision), particularly "Phony," "Realistic/Practical," or "Quick Fix" Decision. At the same time, decisions considering the needs of their countries are also being made. ・Some countries have moved to the fourth stage (Internalization) by accumulating their own experience and knowledge.	Although this may be in line with a global trend, it still corresponds to "4. Borrowed purposefully," that captures the problems of the concerned country and refers to other countries for necessary components.

2.4 Defining the sociocultural aspect of mathematics curriculum

As mentioned in the background of the study, historically, the sociocultural aspect has been interpreted in diverse ways. First, it is necessary to define the sociocultural aspect by analyzing relevant prior studies. Second, sociocultural components which form sociocultural aspect are determined. In addition, a meta-analysis is conducted for each component to capture the trends and characteristics of the previous studies. Baba (2019) described the sociocultural aspect of mathematics education as follows:

> Mathematics has been built by humankind, transcending time and place, and it is an intellectual activity that continues even today. Mathematics education has the responsibility to pass on this activity to future generations. However, modern school education and mathematics education have changed their emphasis with time and in accordance with the social situation of each country. (Baba, 2019, p.2)

Baba (2019) distinguished between mathematics that transcends time and place and mathematics education that is changing with the social situation of each era. In other words, Mathematics education changes with the times, but there are some components that do not change for many years. Both may be considered part of the sociocultural aspect. This is directly linked to educational borrowing in developing countries and justifies the need to refocus on the sociocultural aspect of the curriculum. This section deepens the discussion on the sociocultural aspect of mathematics education based on a literature review and defines it.

2.4.1 The sociocultural aspect of mathematics education as defined by Bishop

Many researchers have examined the sociocultural issues surrounding mathematics education (e.g., Atweh et al, 2010, p. ix). Among them, Bishop led the research on the cultural aspect of mathematics education (Baba, 2019). This dissertation relies on Bishop's (Bishop, 1991, p. 14) idea of the five levels of mathematics education.

Cultural level: Cultural group and mathematics as a cultural phenomenon are clearly supra-societal in nature. Mathematics is the only subject taught in most schools world over.

Societal level: Mathematics is mediated by various institutions in society and is subject

to the political and ideological forces in society. Even if it is an international and cultural phenomenon, there is no reason for mathematics education in one society to be the same as that in another.

Institutional level: Each institution works on the intended curriculum and implements it according to the strengths, weaknesses, constraints, and resources of its staff. The internal structure and "politics" of the institution is a significant factor as is the perceived status of mathematics in the school curriculum.

Pedagogical level: The teacher and the group interact and mold the values that the individual child shall receive vis-à-vis mathematics.

Individual level: While viewing mathematics education as a social process, the individual negotiates, integrates, and makes sense of the different value messages.

At the cultural level, mathematics is divided into school mathematics and mathematics incorporating cultural phenomena that transcend society. Ethnomathematics or the study of the relationship between mathematics and culture is a representative example. In other words, mathematics that exists at the cultural level is rooted in society and can be considered a basis for supporting social standards. Bishop (1991) also mentioned that the cultural level of mathematics education, which is supra-societal, implies the existence of a mathematics culture that cuts across societies. In relation to this, he proposed six universal activities. For example, 'counting' exists in any culture, cutting across societies. Therefore, counting is classified according to the cultural level. He captured ethnomathematics as mathematical activities which transcends societies

At the societal level, mathematics education is influenced by political decisions and ideologies in society. Mathematics education changes based on the era and national system. The content that is borrowed and the method of decision-making depend on politics and ideology. This is consistent with Bishop's societal level of mathematics education (Bishop, 1991).

At the institutional level, the intended mathematics curricula are described as having strengths, weaknesses, and limitations with specific examples. The pedagogical level concerns teachers and children in the classroom, whereas the personal level deals with individual values. Intended mathematics curricula, the main focus of this study, are

positioned at the institutional level. They are developed and revised under the influence of the cultural and societal levels. The cultural level refers to cultural phenomena that transcend society and ethnomathematics is an example. Even at the societal level, there should be individual components. They may be concrete sociocultural components that this study can focus on.

2.4.2 The sociocultural model of mathematics education as defined by Khoon et al.

In defining the sociocultural aspect of mathematics curricula, Khoon et al.'s (2010) "SocioCultural Model in Mathematics Education" was treated as another starting point. This model was chosen because it deals with the sociocultural aspect in a holistic manner. Khoon et al. (2010) reviewed previous studies on the sociocultural aspect and found that although many had focused on individual components, none of them had structurally presented the relationships among them. Thus, this model was developed with a focus on these relationships after covering several studies on individual components pertaining to the sociocultural aspect of mathematics education. They found that previous studies presented a wide variety of sociocultural components that had various influences up to a certain stage of actual classroom lessons. Recognizing the need to capture and present these relationships structurally, they developed a sociocultural model (Situated SocioCultural or SSC model) of mathematics education (Figure 3). This model shows that six mutually related components on the left have an influence on mathematics education, which is placed on the right. The starting point for this sociocultural model is the historical background and cultural mores of the country in question. These two components are the foundations that determine mathematics education. Political events are affected by these two components. Khoon et al. (2010) asserted that educational structure and aims, and language issues are determined by political events, which define the curriculum and the purpose of mathematics education in the country in question. In this model, "language issues" are taken up at the same level as other components. There is no specific reason for this but it is presumed that as a sociocultural aspect, *language issues* are considered crucial and positioned at the same level as "educational structure and aims," which are determined by political events. This model has been revised to suit the teaching language; a series of empirical studies have focused on the teaching language in mathematics education, in areas ranging from policy-making to classroom practice and evaluation (Antonysamy, 2011). Global influence surrounds the whole. In a world where information networks and communications technology have grown, no country can escape the impact of globalization. In this model too, all components are

influenced by globalization, which acts like an umbrella. Regarding "political event", it is a process to determine the structure, aims, and language issues concerning mathematics education (Khoon et al., 2010). Therefore, it is a different type when compared with other components. It can be captured not as a sociocultural component of mathematics education, but rather as a process to determine it.

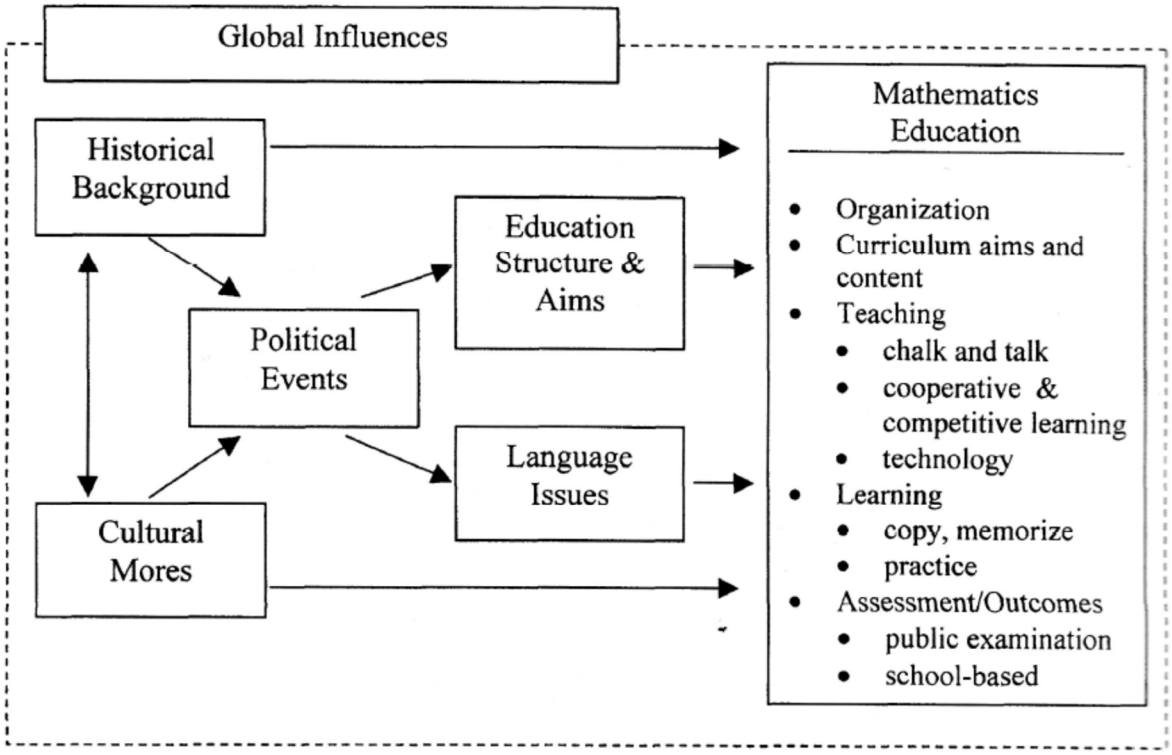


Figure 3. Sociocultural model in mathematics education

(Source: Khoon, et al., 2010, p. 114)

2.4.3 Defining the sociocultural aspect of mathematics curriculum

The five levels of Bishop's mathematics education (1991) was compared with the sociocultural model of mathematics education in Khoon et al. (2010). The cultural level with the history and customs of the country is placed as a base in both models. Bishop considered ethnomathematics a component within the cultural level. Both models consider that the societal aspect is based on the cultural aspect. Bishop mentioned that the social aspect is exposed to political and ideological influences. Khoon et al. (2010) selected political events as a component in their model. Both theories note that the educational system of a country and the objectives of education are created under the influence of various components at the social level. Khoon et al. (2010) identified problems in the language of education as a component influenced by political phenomena. It is also important to acknowledge the

impact of globalization on the sociocultural aspect. The sociocultural aspect is be divided into the cultural and social aspect. The former refers to things that have been formed and are rooted in the country and region over time. The latter is developed based on the former, and is influenced by political components and ideologies prevailing in society. Therefore, they change with the times. The sociocultural aspect can be defined as the integration of the cultural aspect that is formed and rooted in the country with the social aspect that is shaped based on the cultural aspect. In this study, we call them sociocultural aspect of mathematics curriculum as a whole. It includes the components that have been formed by groups within society or that are influenced by external factors, as well as components that are inherent in the mathematics curriculum. The specific items that constitute the sociocultural aspect are called "components." For example, with regard to the language issue that was cited by Khoon et al. (2010), using the local language as a language of instruction can be seen as a cultural aspect since it is something that has remained unchanged in culture for a long time. On the other hand, using a language used by colonials or using English to consider the recent global trend can be seen as a global trend as it is influenced by external factors. We shall take them collectively as the sociocultural aspect. The specific items that constitute the sociocultural aspect are called components.

Regarding the sociocultural aspect of the mathematics curriculum development, which is the main subject of this research, the author derives its components that specifically influence the development and revision of the mathematics curriculum along with the defined sociocultural aspect.

2.5 Meta-analysis of the sociocultural aspect of mathematics curriculum development

In this section, components that have a concrete influence on sociocultural aspect of mathematics curriculum development are derived, analyzed, and discussed. The sociocultural components that should be noted are derived, and the research trends in each era are understood through a meta-analysis of existing studies.

2.5.1 Meta-analysis of international handbooks by Baba and Gonzalez (2016)

Baba and Gonzalez (2016, p. 159) described the features of the handbook as follows: "The handbook has been prepared by compiling and clarifying past achievements in specific fields and research subjects. It often states something that has not been made clear, whether intentionally or unintentionally. Due to the nature of the compilation, it is necessary to cover the articles as comprehensively as possible, and to express the relationships with each other

like a map, which gives the handbook comprehensiveness and theoretical diversity." Clandin (2007) indicated that the main purpose of editing the handbook was to compile a general, prospective, and retrospective overview of the disciplines in question, and noted that it is a rich and critical evaluation of theory both in the past and present in the relevant disciplines with the aim of paving the way for future. The handbook spans the entire timeline from the past to the future and includes the quantitative aspect of comprehensive articles. Thus, it is a good starting point to derive the sociocultural components while comprehensively analyzing the sociocultural aspect of the mathematics curriculum. Therefore, it was found appropriate to refer to Baba and Gonzalez (2016). From three handbooks, that is, the International Handbook of Mathematics Education (Springer), the Handbook of International Research in Mathematics Education (Lawrence Erlbaum/Routledge), and the Handbook of Research on Mathematics Teaching and Learning (NCTM), they analyzed the issues that frequently arise in the context of society, culture, and politics, and listed the components as shown in Table 5.

Table 5. Components extracted by Baba and Gonzalez (2016)

Societal aspect	Democracy, access, gender, social justice (gender, ethnicity, economic status)
Cultural aspect	Ethnomathematics and Linguistics
Political aspect	Equity, International competition, and Globalization

The author reorganized these components with due consideration for the discussion on the definition of the sociocultural aspect presented in the previous section. First, *ethnomathematics* and *linguistics* are cited as part of the cultural aspect. They coincide with the components specifically addressed in both frameworks referred to in the discussion on the definition of the sociocultural aspect. Therefore, both these were chosen as sociocultural components in this study.

Second, Khoon et al. (2010), identified the political aspect as a process to determine the sociocultural components. Baba and Gonzalez (2016) also captured it as an aspect, and categorized three specific components, namely *equity*, *international competition*, and *globalization*, under it. Therefore, these components are also discussed in this study. In terms of equity, the components classified as societal aspect are related to it. Lubienski and Bowen (2000) surveyed 3011 published articles in 48 mathematics education-related journals between 1984 and 1998 based on data drawn from the Education Resource Information

Center (ERIC). They stated that *gender, ethnicity, and social class* were related to *equity*. As *democracy* and *access*, which are classified as the societal aspect can be discussed in the context of equity, judging from the titles of the articles they mentioned, both components were included within the scope of equity. Therefore, equity is one of the sociocultural components of this study.

As *international competition* can be transferred as a component of *globalization*, it is discussed under *globalization*. *Globalization* was specifically identified in Khoon et al. (2010) as the basis for defining the sociocultural aspect. It is extremely important against the backdrop of rapid globalization. Thus, globalization was chosen as one of the components of this study.

Overall, *equity*, *linguistics*, *ethnomathematics*, and *globalization* were identified as components constituting the sociocultural aspect.

Table 6. Components discussed by each researcher

Researcher	**Components**	**Remarks**
Bishop (1991)	✓ **Ethnomathematics** (Cultural level)	
Khoon et al. (2010)	✓ **Linguistics** ✓ Political events (process to decide the components) ✓ **Global influence**	Political events constitute a process to decide the components
Baba and Gonzalez (2016)	✓ **Linguistics and ethnomathematics** (Cultural component) ✓ Democracy, access, gender, ethnicity, and economic status (Societal aspect) ✓ **Equity, International competition, and globalization** (Political aspect)	Components in the societal aspect are categorized under equity (Lubienski & Bowen, 2000)
This study	✓ **Equity, linguistics, ethnomathematics, and globalization**	

Source: Developed by the author

2.5.2 Meta-analysis of Educational Studies in Mathematics (ESM) and Journal for Research in Mathematics Education (JRME)

(1) Steps in the meta-analysis

A meta-analysis captures trends in previous research. In this study, the focus was on trends in the four components, namely *equity, linguistics, ethnomathematics,* and *globalization.* Two target journals that deal with content on mathematics education with the highest impact factors were analyzed, namely Educational Studies in Mathematics (ESM;

published by Springer since 1968, three volumes annually) and Journal for Research in Mathematics Education (JRME; published by the National Council of Teachers of Mathematics (NCTM) since 1970, five volumes annually). Liu (2017) mentioned that these two journals are appropriate to capture the trend in mathematics education for two reasons: both journals are indexed by the Social Science Citation Index (SSCI), which is a well-recognized trademark for quality journals, and each have an established reputation in publishing research articles on mathematics education. The meta-analysis comprised the following steps:

1) All articles published in both journals from 1980 to 2020 were targeted.
2) The articles that included the four components in the title were extracted. The abstract was examined to understand the objective of the article. If the objective was not clear even after reading the abstract, the entire article was read and a decision was made on whether or not to include it.
3) Components that were extracted individually in Baba and Gonzalez (2016) such as *democracy, access, gender, ethnicity,* and *wealth* were targeted. They were analyzed in line with the process followed in step 2.
4) If the title had multiple components, the abstract or the subject of the article was relied on to determine the focus of the study.
5) The trend for every 10 years was summarized by focusing on the number of published articles and their subject in each sociocultural component.

(2) Summary of the results

All the results of the meta-analysis are attached as a reference (Appendix 1 and 2). Table 7 presents the number of articles by journal and component. The total number of articles is almost the same between both journals. The number of articles on equity was overwhelmingly large when compared to those on others. Further, JRME published more articles on equity than did ESM. JRME is published by the NCTM. As equity is the first principle of mathematics education (NCTM, 2014), it was presumed to be the reason for the many publication of research on equity in JRME. On the other hand, JRME published fewer articles on ethnomathematics and globalization when compared to ESM.

Table 7. Number of articles in ESM and JRME

Journal	Component	1980s	1990s	2000s	2010s	Total
ESM	Equity	5	12	5	9	31
	Linguistics	8	4	12	10	34
	Ethnomathematics		2	3	4	9
	Globalization		2	3	7	12
	Total of ESM	13	20	23	30	86
JRME	Equity	26	9	9	14	59
	Linguistics	4	3	2	4	13
	Ethnomathematics	1	3			4
	Globalization	1	1	4	1	7
	Total of JRME	32	16	15	20	83

1) Results of the analysis of ESM

Table 8 summarizes the number of articles and the content of discussions on the four components as derived from ESM. A total of 31 articles dealt with equity, where research is being actively conducted along with articles on linguistics. Research on gender has been ongoing since the 1980s. In the 1980s and 1990s, most articles focused on the relationship between gender and mathematics achievement (e.g., Leder, 1985; Hoff & Hall, 1988; Cheung, 1989). However, since the 2000s, research began to be informed by new perspectives such as the relationship between gender, and stereotypes and beliefs pertaining to mathematics (e.g., Tiedenmen, 2000; Leder & Vale, 2004). Various items including gender and degree of achievement in mathematics were examined in 2000s and 2010s. Research on the relationship between socioeconomic status and mathematical ability has been ongoing since the 1990s (e.g., Kaelely, 1990; Cooper & Atweh, 1995; Irwin & Irwin, 2005). In the 2010s, articles on mathematically talented students and inclusiveness were published (Eun-Sung et al., 2014). Articles on equity in early childhood education were also published in the 2010s (Lindberg et al., 2013), which means that the scope of coverage had expanded to include primary and early childhood education.

A total of 34 articles dealt with linguistics. There were fewer studies in the 1990s than in other time periods. However, the subject has been actively studied since the 1980s. From the 1980s to the present, research on learning mathematics in a second language and its effect on academic ability has been actively undertaken. There is a difference in the meaning of the second language. Many studies in the 1980s and 1990s considered the official language used in schools as the second language, and distinguished it from the mother tongue used at home (e.g., Zepp, 1982; Dawe, 1985; Clarkson, 1992). Since the 2000s, English was taken up as a second language in monolingual countries and regions (e.g., Barwell, 2003; Clarkson,

2006; Mosxhkovich, 2007). This shows that even in countries where students learn in their mother tongue or language of their own country, they used English for mathematics. This trend is related to rapid globalization that began to unfold since 2000. In the 2010s, research began to focus on social skills, such as discourse ability and mathematical communication in class (e.g., Oi-Lam, 2016; Heller et al., 2018). This trend may have been influenced by international policies.

Since the 1990s, about two to four articles were published on ethnomathematics every 10 years. In the 1990s, articles focused on the meaning and criticisms of ethnomathematics (Barton, 1996; Skovsmose, 1997). In the 2000s, the main focus was on practical research on the relationship between ethnomathematics and mathematics taught at school (e.g., Carson, 2002; Barton et al., 2003). In the 2010s, articles focused on philosophical perspectives in and suggestions obtained from ethnomathematics (e.g., Vilela, 2010; Francois & Pinxten, 2011). Since the 2000s, there were discussions to develop ethnomathematics, and some studies critically considered it, while also utilizing the suggestions obtained in mathematics education.

The number of articles that focused on "globalization" continued to increase since the term first appeared in the 1990s. Most articles focused on the analysis and criticism of PISA and TIMSS (e.g., Donn & Robitaille, 1992; Saenz, 2009), and on global and local comparisons (e.g., Kuntze, 2012). In the 2010s, articles focused on international comparisons of lifelong learning (Evans & Tsatsaroni, 2014). One article focused on the relationship between the context of large-scale assessment and bilingual students (Civil et al., 2017). These research trends may have been influenced by global trends. As shown in the sociocultural model of mathematics education in the previous section, globalization is a component related to all sociocultural aspect.

The research subjects related to the four components are not independent of each other, but were rather mutually related. "Equity" and "globalization" are characteristic examples. For instance, a lot of studies that examined "linguistics" focused on mathematics learning in multilingual classes in recent years, driven by the concept of "equity." Students whose mother tongues are not the official language should be given the opportunity to learn mathematics like students whose mother tongues are the official language. Globalization has a significant influence on the reason for multilingual classes gaining popularity. The discussions on globalization also relate to the idea of "equity."

Table 8. Number of articles and content of discussions on the sociocultural aspect in Educational Studies in Mathematics (ESM)

	Equity		Linguistics		Ethnomathematics		Globalization	
1980s	・Gender differences and theoretical thinking in mathematics (e.g. Leder, 1984) ・Gender differences in mathematics curricula (Cheung, 1989) ・Relationship between gender differences and math achievement (e.g. Cathy and Cynthia, 1988)	5	・Relationship between math achievement and fluency in the second language (e.g. Zepp, 1981) ・Differences in the logical thinking of mathematics between the second language and the mother tongue (e.g. Berry 1982) ・Learning a second language through mathematics and learning mathematics in a second language (Alladina, 1983) ・Typical mistakes in mathematics because of the differences between Chinese and English (Zepp, Monin & Lei, 1987)	8				
1990s	・Conversation and gender in mathematics classes (Jungwirth, 1991) ・Gender difference in attitudes toward mathematics (e.g. Relich, 1996) ・Relationship between mathematics achievement and gender (Tartre and Fennema, 1995) ・Mathematics understanding among students from different socioeconomic backgrounds (e.g. Kaeley, 1990) ・Gender difference in mathematics, relationship with culture (e.g. Byrnes, Hong & Xing)	12	・Comparison between bilingual and monolingual students (e.g. Clarkson,1992) ・Influence of language on word problem (e.g. Adetula, 1990) ・Creating mathematics through language and experience (Brown, 1994)	4	・Understanding the meaning of ethnomathematics (Barton, 1996) ・Criticism of ethnomathematics (Barton, 1996)	2	・Global perspective on mathematics classrooms (using data from the UN such as population and life expectancy for lessons)（Hudson, 1990） ・Introduction to TIMSS (Robitaille & Donn, 1992)	2

2000s	・Mathematics education for ethnic minorities (MulatAbraham & Arcavi, 2009) ・Beliefs of a mathematics teacher with respect to gender (Tiedemann, 2000) ・Teachers' gender stereotypes (Tiedemann, 2002) ・Gender differences in computer-based mathematics education (Colleen et al., 2002) ・Mathematics in students with different socioeconomic backgrounds(Kathryn et al., 2005)	5	・Teaching mathematics in a multilingual classroom (e.g. Planas, 2001) ・Content to be aware of when using English as an additional language in primary mathematics (Gutstein, 2007) ・How to use language in mathematics for advanced bilingual students (Clarkson, 2006) ・Language and culture in mathematics education (Stathopoulou & Kalabasis, 2007) ・Learning math using two languages (e.g. Moschkovich, 2007) ・Influence of language on word problem (Ríordáin & O'Donoghue, 2009)	12	・Criticism of the relationship between ethnomathematics and formal mathematics and its response (e.g. Rowlands & Carson, 2002)	3	・Building an international sense utilizing global data (Ben-Zvi & Arcavi, 2001) ・Teaching materials from local and global perspective (Alsina, 2002) ・Role of contextual, conceptual and procedural knowledge in PISA (Sáenz, 2009)	3
2010s	・Teacher instructions for impartial teaching (Hand, 2019) ・Diversity and equity in the classroom (e.g. Zhu et al., 2018) ・Gender equality in achievement of mathematics (e.g Sarouphim & Madona, 2017) ・Mathematics education for gifted students (Bruria et al., 2014) ・Gender differences in attitude and achievement in mathematics (Forgasz et al., 2014)	9	・Solving addition and subtraction in word problems in English (e.g. Verzosa & Mulligan, 2013) ・Language as a resource for understanding the complexity and concepts of mathematics (Planas, 2018) ・Discourse ability in math class (e.g. Erath, Prediger, Quasthoff & Heller, 2018) ・Interaction of language and gesture in mathematical communication by bilingual learners (e.g. Ng, 2016)	10	・Philosophy of ethnomathematics (Vilela, 2010) ・Criticism of ethnomathematics and its contradiction (e.g. Pais, 2011) ・Implication of ethnomathematics (Pinxten & François, 2011)	4	・Globalization of educational content (e.g. Kuntze, 2012) ・International surveys on lifelong learning (Tsatsaroni & Evans, 2014) ・Cause analysis for Finland TIMSS and PISA results (Andrews, Ryve, Hemmi& Sayers, 2014) ・Criticism of PISA mathematics regime (Fernandes, Kahn & Civil, 2017)	7

2) Results of the analysis of JRME

Table 9 presents the number of articles and the content of discussions on the four sociocultural components in JRME. The largest number of articles were published on "equity." among the four sociocultural components. Most of the content pertained to "gender," "race and ethnicity," and "socioeconomic status." In particular, "gender" has a large number of articles and can be said to be the focus of research on the component of "equity." Research on the relationship between gender and academic ability in mathematics has been consistently undertaken since the 1980s (e.g., Fennema et al., 1980; Ethington, 1990; Walshaw, 2001; Ganley et al., 2013). Studies on women's participation in and attitudes toward mathematics were published in the 1980s (e.g., Elizabeth et al., 1980, Collins, 1987). Since the 1980s, research focused on participation in mathematics and attitudes, as well as the relationship between gender and mathematics. Research on mathematics education for Native Americans was published in the 1980s (Bradley, 1984; Cheek, 1984), but not thereafter. Studies on the challenges of mathematics education posed by the US immigration policy, such as regarding Blacks, Hispanics, and Asian Americans, have been conducted over time (e.g., Davenport, 1984; Cooper, 1997; Gustein, 2003; Bartell, 2013). Several articles have dealt with the relationship among socioeconomic status, and academic ability and achievement, and have been published every 10 years since the 1990s (e.g., Gersten & Carnine, 1982; Kaelely, 1990; Strutchens et al., 2006). "Socioeconomic status" is gaining importance in research. In some studies, the word "equity" is used in the title, wherein the article focuses on race, ethnicity, language, gender, and socioeconomic status. The following definition of equity by NCTM (2014, p.1) encapsulates this phenomenon best:

- Being responsive to students backgrounds, experiences, cultural perspectives, traditions, and knowledge when designing and implementing a mathematics program and assessing its effectiveness.
- All students routinely have opportunities to experience high-quality mathematics instruction, learn challenging mathematics content.
- All students attain mathematics proficiency and increasing the numbers of students from all racial, ethnic, linguistics, gender, and socioeconomic groups who attain the highest levels of mathematics achievement.

A total of 13 articles focused on "linguistics." Since the 1980s, 2 to 5 articles were published in each decade. Most articles presented case studies on the relationship between

language and the conceptual understanding of mathematics and the relationship between language ability and mathematics learning. Until the 1990s, there was a large number of theoretical studies (Cuevas & Llabre, 1983; Cuevas, 1984; Katriel & Nesher, 1986), but since the 2000s, the number of empirical studies through classroom practice such as teaching in multilingual classes began to increase (e.g., Montis, 2000; Shein, 2012). Content related to inclusive education, such as learning mathematics in sign language, which has been discussed from the perspective of "equity" appeared in the 2010s (Nathan et al., 2017; Krause, 2019).

There are a few studies in which the word "ethnomathematics" has been mentioned in the title or summary, but only a few linked mathematics and culture in the 1980s and 1990s (e.g., Eisenhart, 1988; Bechker & Kitchen, 1998).

The number of articles on "globalization" is also small. As with ESM, most research published in JRME also dealt with international comparisons of mathematics education. However, in the 2010s, an article on the nationalization of mathematics education was published. Much like ESM, the four components were inter-related in JRME as well. Various studies were conducted on "equity." For example, studies that focused on linguistics looked at mathematics learning in second and sign languages. All these studies centered on equity. Some studies had a global perspective, and focused on areas such as gender equity and teaching practice in a global context.

Table 9. Number of articles and content of discussions on the sociocultural aspect in Journal for Research in Mathematics Education (JRME)

	Equity		Linguistics		Ethnomathematics		Globalization	
1980s	・Mathematics education for indigenous people in America (e.g. Matthews, 1984) ・Mathematics education for Black, Asian American, and Hispanic students (e.g. Valverde, 1984; Tsang, 1984) ・ Relationship between mathematical ability and race, ethnicity, and gender (e.g. Ethington & Wolfle, 1984; Hanna, 1986) ・ Relationship between gender and academic ability (e.g. Ethington & Wolfle, 1984; Hanna, 1986) ・Women's participation in mathematics (e.g. Marrett & Gates, 1984 ・ Gender differences in attitude toward mathematics (Hart, 1989)	26	・Mathematics learning for Hispanic bilingual students (Maria et al., 1983) ・Mathematics learning for children for whom English is the second language (Cuevas, 1984) ・Role of language in learning numbers (Nesher & Katriel, 1986) ・Word Problems and language factors (Adetula, 1989)	4	・Relationship between ethnic studies and mathematics education studies (Eisenhart, 1988)	1	・Cultural comparison of children's spatial perception (Shar & Geeslin, 1980)	1
1990s	・Socioeconomic status and mathematical ability (Kaeley, 1990) ・International comparison of the relationship between gender and academic ability (e.g. Ethington, 1990) ・Relationship between mathematics education and politics (national curriculum, test system)(e.g. Apple, 1992) ・ Gender differences in mathematics; attitude, strategies, psychological model etc. (e.g. Seegers and Boekaerts, 1996) ・Social context in the mathematics classroom (e.g. Atweh, Bleicher & Cooper, 1997)	9	・ Relationship between bilingual and mathematical ability (Clarkson & Galbraith, 1992) ・Relationship between algebraic learning and language skills (MacGregor & Price, 1997) ・Conversation in mathematics classroom (Forrester & Pike, 1998)	3	・Cultural tools and mathematics learning (e.g. Resnick et al., 1995) ・Challenge of ethnomathematics to Western mathematics (Kitchen, 1998)	3	・International trends in mathematics education and research (D'ambrosio & D'ambrosio, 1994)	1

2000s	・Equity issues in mathematics curriculum (e.g. Jo, 2002) ・ Social justice in mathematics education (Gutstein, 2003) ・ Equity issues in mathematics education (e.g. Tunis et al., 2005) ・Equity in mathematics assessment (Ortigão, 2007) ・ Relationship between gender, race and socioeconomic status in mathematics (Strutchens et al., 2007)	9	・Language development and computation ability (Montis, 2000) ・Mathematics teaching in a multilingual classroom (Setati, 2005)	2			・ NCTM evaluation based on TIMSS video study (e.g. Kai et al., 2006) ・ International collaboration of mathematics education researchers (e.g. Ferrini-Mundy & Schmidt, 2005)	4
2010s	・ Social beliefs about gender differences in academic ability (e.g. Lubienski et al., 2013) ・Equity issues in the Common core state standard (e.g. Kitchen and Berk, 2016) ・Classroom discourse and equity (e.g. Reinholz and Shah, 2016) ・Fair teaching in classrooms with mixed races (e.g. Louie, 2017) ・Goals and social justice for mathematics education (e.g. Harper, 2019)	14	・Mathematics education and language diversity (Mamokgethi, 2013) ・Effects of gesture instruction on students learning mathematics in foreign languages (e.g., Williams-Pierce, 2017) ・Mathematics education by sign language (Krause, 2019)	4			・ Nationalization of mathematics education (Warburton & Buendia, 2016)	1

2.5.3 Relationships among the sociocultural components

The sociocultural components were inter-related. Globalization is closely related to other components. The two journals are combined and discussed comprehensively in this segment. Both journals published a certain amount of articles on linguistics for each decade since the 1980s. Throughout all periods, though the focus has changed, it has primarily centered on learning mathematics in a second language. In the 1980s, studies that focused on the conceptual understanding and achievement of mathematics examined the differences between the mother tongue and the second language used in school. In the 1990s, there was an increase in research on the differences between bilingual and monolingual students in learning mathematics, and mathematics teaching in multilingual classes. It is thought that research has become more active as such situations have increased in response to the trend of globalization. Since the 2010s, both journals began to publish articles on sign language instruction and gesture-based mathematics education for students who cannot communicate verbally. These articles pertain to inclusive education, which is also discussed as "equity".

Both journals have been actively discussing "equity" since the 1980s. JRME has a larger number of articles on "equity" when compared to papers on the other three components. This may be because equity is the first principle of mathematics education in the US, and this is analyzed in detail in global discourses and policy transitions in the next section. In both journals, "gender" and "socioeconomic status" are major focus areas. JRME has also covered research on "race/ethnicity." Research on gender differences in mathematics achievement and attitudes toward mathematics has been ongoing since the 1980s. The main target is primary and secondary education. However, in the 2010s, research on early childhood education was also undertaken. Several studies focused on the teachers' gender since the 2000s. Research examining the relationship between gender and mathematical ability/attitude is accumulating and expanding the range and scope of the extant literature. Research on the relationship between socioeconomic status and mathematical ability has been undertaken since the 1990s. Since the 2000s, the titles of articles have included the word "equity," and many studies have been published on socioeconomic status. Inclusive and mathematics education for talented children has also been a major perspective since 2000. These facts are presumed to be in line with global education policy trends.

The relationship among the four sociocultural components were examined based on Baba (2020), which captured the sociocultural aspect from the three perspectives of purpose, method, and content. Figure 4 presents the relationship among the four most discussed

sociocultural components in mathematics education, extracted from the meta-analysis of previous studies. First, all the sociocultural components were studied and discussed bearing "equity" in mind. "Equity" is linked to the aim of education. Second, there were studies on mathematics learning in the mother tongue, the language of the mother country, and foreign languages, and research on mathematics instruction in multilingual classes has been conducted in recent years. However, these are discussions to achieve "equity" whereby each child can learn mathematics in the environment in which they are placed regardless of differences in the mother tongue. Thus, there have been discussions on equity with respect to educational means. Third, D'Ambrosio (1985), the creator of ethnomathematics, stated that its main goals were to build an emancipated civilization founded on truth, and free of arrogance, intolerance, discrimination, inequality, prejudice, and hatred. In other words, the content of ethnomathematics aims at the realization of "equity." Finally, regarding 'globalization', it became clear from the meta-analysis of previous studies that it is a component that influences all sociocultural aspect.

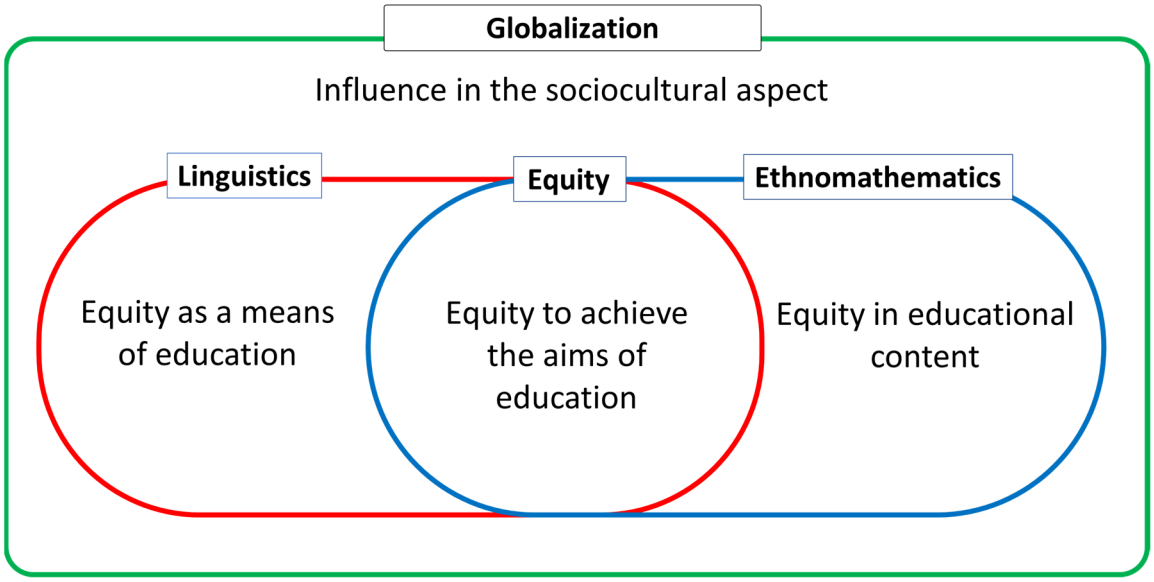


Figure 4. Relationship among the four sociocultural components

These four components influence the development of mathematics curricula. In other words, they serve as a lens to analyze mathematics curriculum development from the outside. On the other hand, these four components are embodied and internalized in the curriculum through the development process. In the case study of Mozambique in Chapter 4, these four components embodied in the mathematics curriculum are analyzed.

2.6 Global discourse on the sociocultural aspect of mathematics curriculum development

It is important to consider not only the academic research trends but also the global discourses and policies as they influence the actual curriculum development. The global discourses and policies of the four sociocultural components are analyzed. In addition, the relationship of the components is also discussed according to the framework developed based on the academic research in the previous section. This analysis serves as a reference to analyze the characteristics of the sociocultural aspect of Mozambique's mathematics curriculum.

There are criticisms that global discourses and policies are biased in favour of developed countries (Heyneman et al., 2016). Discussions on education at global level have been led by UNESCO. UNESCO led regional education planning in the 1960s, and has focused on promoting education as the EFA, along with other agencies since 1990. The OECD is an organization that represents economic partnerships of developed countries. Therefore, the only reports issued by international organizations such as UNESCO and OECD were selected to analyze global discussions. ICME was also included as the largest professional organization of mathematics education in the world. The discussion of topic study group (TSG) in the conferences is often analyzed as the global trend of mathematics education.

2.6.1 Equity for educational aims

The meta-analysis showed that it is clear that "equity" lies at the center of everything, and other sociocultural components related to educational content and methods are studied and discussed with "equity" in mind. "Equity" is a sociocultural component that leads to the aims of education. It is different from "equality," and the difference between the two is a fundamental issue in pedagogy (Sugimura, 2019). EFA has sought to enable access to universal and equal education for children in primary school. The goal has been to achieve "equal opportunity." Now that EFA has almost been achieved, the realization of "equal opportunity" is not enough, and "equity," namely ensuring equality considering the unique situations and conditions of each individual, has become important. In the context of mathematics education, teaching all students the same content and level of mathematics is *equality* but, it is not *equity*. The meta-analysis showed that research on "equity" has focused on gender, race, ethnicity, and socioeconomic status. Table 10 summarizes the global discourse and policies.

Table 10. Equity in global discourses and policies

1980s	1984: The 5th International Congress on Mathematical Education (ICME5): MFA 1989: UNESCO Report: Three concepts pertaining to equity - Educational participation of women and rural residents - Curriculum on unfair treatment by teachers and multiculturalism - Learning outcomes
1990s to 2000s	1990: EFA: Setting of 5 items in equity 2004: ICME 10: Activities and programs for mathematically talented students
2010s	2015: Education 2030 and SDG 4

Research focusing on gender, race, ethnicity, etc., has been ongoing since the 1980s. The international focus on "equity" in the world of mathematics education was triggered by the 5th International Congress on Mathematical Education (ICME5) held in 1984. There, a thematic group called MFA was set up, and the mathematics curriculum from the perspectives of developing countries, ethnic minorities, different gender identities, etc., was raised (Damerow et al., 1984). ICME6, held in 1988, organized a program called "Mathematics, Education, and Society" for various groups that had limited opportunities for learning and participation in mathematics education. There was a discussion on how institutionalized mathematics education is embedded in society, and the development of a mathematics curriculum that deals with social issues to enrich the experience of all students. A school mathematics curriculum to eliminate social disparities was proposed (Nyein, 2006). In a working group of the ICME9 held in 2000, equity issues were discussed with respect to three topics, namely "mathematics education in the global age," "mathematics education policy," "social justice in gender, race, social class, and ethnicity and policy" (Keitel & Kninjik, 2000). ICME10 was held in 2004. Since then, a research theme called "Activities and Programs for Mathematically Talented Students" has been pursued continuously. There have been discussions on various areas including the educational system, on the kind of guidance that should be given to mathematically gifted students.

The first time equity issues received global attention was in a report by the UNESCO in 1989, which mentioned three topics: access to educational participation by women and rural residents, lack of curricula to deal with fair treatment by teachers and multiculturalism, and learning outcomes (Nyein, 2006). These three formed the basis for equity in the 1990 EFA Declaration. Article 3 of the EFA Declaration listed the following five items vis-à-vis equity: 1) Basic education should be provided to all children, adolescents, and adults. 2) All children, adolescents and adults should be given the opportunity to reach and maintain

acceptable levels of learning. 3) Qualitative participation of all women in education should be ensured, and gender stereotypes should be eliminated. 4) There should be no discrimination in learning opportunities or participation in education. 5) Persons with disabilities should be able to participate in education like everyone else (WCEFA, 1990). Item 2 mentions all categories, namely children, adolescents, and adults, and at this point, the concept of lifelong learning had already been considered. Item 5 addressed the inclusion of persons with disabilities. Next, OECD Education 2030, which formed the basis of SDG 4 in which the UN set development goals for education by 2030 in 2015. There, "equity" is explained thus: "Curricula should ensure equity while innovating; all students, not just a select few, must benefit from social, economic and technological changes" (OECD, 2018). The statement implies gender, ethnicity, people with disabilities, and socioeconomic status, that have been discussed so far. It states that no one should be left behind by the changes in society, economy, and technology and that all must benefit from them. Among the components discussed from the perspective of "equity," "gender," and "socioeconomic status" have been continuously discussed from the 1980s to date. Research on gender in mathematics education has made apparent differences in various areas between boys and girls in mathematics learning, such as in learning achievement and cognitive methods. Gutiérrez (2013) warned that the idea of making girls and boys by treating them equally lies at the root of the gender policies developed to address the challenges identified by these studies. It confuses "equity" with "equality." It is fair to consider the policies that are suitable for each after clarifying the differences based on their positions. Future research should focus on this area in mathematics education, and the results should be correctly reflected in policies.

"Socioeconomic status" has been discussed since the 1980s. These discussions have become more active in recent years. The PISA results from the OECD in 2012 revealed that socioeconomically superior students performed about one grade higher than those who were not (OECD, 2013, p.13). Pickett and Wilkinson (2015) pointed out that in order to reduce the impact of socioeconomic status on academic achievement in mathematics, it is necessary to eliminate differences such as in the materials provided. As the difference in socioeconomic status between nations and within a country is expected to widen in the future, research and discussions should bear "equity" in mind, and appropriate policies should be implemented.

As mentioned above, both EFA and MFA have the perspective of equity, and discussions are proceeding from their respective standpoints. EFA focuses on gender, ethnicity, age, socioeconomic class, and inclusiveness with the aim of providing basic

learning opportunities for all. There have been active debates on the educational system that may eliminate differences in these areas. On the other hand, MFA also focuses on gender, ethnic, and socioeconomic perspectives, but the discussions are rooted to the context of mathematics education, which calls for the development of a mathematics curriculum that eliminate discrimination. Therefore, examining issues in mathematics education and measures to deal with them, with "equity" as a focus, is consistent with the educational goals and universal concepts of human rights in EFA.

To summarize the discussion so far, in the world of mathematics education regarding "equity", the ICME in 1984 triggered the discussion. As a trend of international debate, it began to be recognized in the EFA Declaration in 1990, and the demand for consideration of equity increased further in the SDGs in 2015. With the increasing globalization of society, the pressure that equity should be taken into consideration in the educational system and curriculum is increasing year by year. In the 1990s, the main focus of discussions from the perspective of "equity" was language, gender, race, ethnicity and socioeconomic status, but in recent years, talented students and lifelong learning are also being addressed, so the range of items is expanding.

2.6.2 Linguistics: Equity for educational means

"Linguistics" is associated with the educational means of achieving "equity." This was specifically taken up as a component in the sociocultural model of mathematics education created by Khoon et al., which formed the basis for the definition of the sociocultural aspect of mathematics education. Further, the meta-analysis shows that this has been studied from the 1980s to the present. Table 11 presents the global discourses and policies, from the 1980s to the present.

Table 11. Linguistics in global discourses and policies

Late 1990s and 2000s	・ Resolution on provisions for multilingual education (cf. General Conference Resolution 30 C/12): Use three languages: one's mother tongue, the language of one's country, and an international language. For the first few years of learning, using one's mother tongue is desirable.
2010s	・ SDGs Goal 4.5: Let people receive high-quality education regardless of the type of "language."

At the 30th meeting of the UNESCO General Assembly in 1999, a resolution on establishing the concept of "multilingual education" was adopted. Multilingual education

refers to the use of native, local, national, and/or international languages in education. UNESCO has promoted multilingual education as a means of improving learning outcomes and maintaining cultural diversity. At least six years of native language education are essential to reduce the learning gap for second language speakers.

In response to this trend, mathematics education in English as a second language has been promoted even in single language nations, with some countries adopting English as the teaching language in the primary or secondary education stage (Chi, 2017). Many other countries, both developed or developing, have also begun to make major shifts to bilingual education such as by using the mother tongue and English (Chi, 2017). As Table 11 shows, research on mathematics teaching/learning in multilingual classrooms and immersion mathematics education in English began in the latter half of the 1990s. However, the UNESCO report issued in 2016 states that the dominant language is the language of instruction in some multilingual countries, and that 40% of the world's population is still not educated in their mother tongue at the primary education level. In African countries, where the situation remained complex even after independence owing to colonial policies made mainly by Western countries, a conference held by UNESCO in 1998 for establishing language policy strategies in political and technical aspects among African nations. The need to adopt a clear policy on the use of the mother tongue was stressed, and the action plan declared it a medium- to long-term effort; it also noted that the language of the region should be the teaching language (UNESCO, 2002a). Theoretical and empirical research has been actively undertaken on education in the local language since then. Nji (2004) noted that when compared to European languages, African languages do not have a solid foundation of terminologies in science and technology, and do not have sufficient technical vocabulary to teach the subjects covered in class. In response to this point, Bamgbose (2004) argued that the fact that other languages had gone through a similar process was ignored, and noted that all languages were capable of continually developing and adapting to new experiences.

Discussions from the social aspect are also actively taking place. There was some opposition from parents who believed that learning in English would provide greater access to the world, over learning in their native language in African countries (Pateman, 2012). Kashima (2005) pointed out that while pedagogues and intellectuals preferred to pursue basic education in their mother tongue, parents wanted their children to be educated in English. People in those societies did not necessarily want an education in their mother tongue. People opted for this as knowledge, information, higher education, and employment opportunities are often gained through European languages like English and French. A few countries have

succeeded in reforming their educational programs in terms of increasing programs in the mother tongue as the change in language policy is often linked to a change in the political power of the country, which is a complex problem (Setati, 2005, p.450).

In the 2010s, research began to focus on communication and discourse in mathematics classes. It is presumed that the key competencies (OECD, 2005a) shown by the OECD as necessary abilities for in the coming era, and the 21st century skills advocated by the 21st Century Skill Effect Measurement Project of the international organization "ATC21s" have influenced the curricula of each country. As a result, metacognition, which is a higher cognitive ability, and communication as a social skill, have come into focus. Research comparing courses in the mother tongue and English have also been undertaken. Tan (2007) stated that English as a second language plays a more important role in the contextual discourse than in the discourse on mathematical concepts. As Berry (1985) pointed out, the recognition of mathematical concepts is associated with the natural cognitive structure of the student's mother tongue, which makes it difficult to explain them in their second language, English. Therefore, while recommending multilingual education, UNESCO has argued that it is desirable to study in the native language for several years after the start of learning.

As mentioned above, it is seen that “Linguistics” is closely related to the culture of the country or region. Receiving mathematics education in one’s mother tongue promotes conceptual understanding and a higher degree of learning achievement. UNESCO promotes mother tongue education for about six years after the start of school education. On the other hand, while educational language policy is closely related to the politics of the country, parents may want their children to be taught in English or in any of the other major languages of the world rather than the mother tongue. This is a complex issue that is strongly influenced by the social aspect of the country's politics and ideology.

2.6.3 Ethnomathematics: Equity in the educational content

“Ethnomathematics” can be discussed in terms of equity in the educational content. It is also mentioned as a specific example of educational content at the cultural level in the five levels of Bishop's mathematics education as seen in Chapter 2. It is mathematics that is rooted in the local culture of the country. The term “ethnomathematics” was coined in 1984 by Brazilian mathematics education scholar D'Ambrosio, who stated that although mathematics is encountered in daily life, mathematics taught in the classroom is completely unrelated to it. Focusing on the dichotomy between both streams, he sought to critically examine the ideal form of mathematics education. Ethnomathematics was introduced by

D’Ambrosio at ICME5 in 1984. Since then, ethnomathematics has been set as a Topic Study Group (TSG) of ICME and discussions continue. The Ethnomathematics Study Group (Topic Study Group 35) of ICME-13 in 2016 compiled the past discussions and future possibilities on Ethnomathematics in a handbook 'Current and Future Perspectives of Ethnomathematics as a Programme (Rosa et al., 2016)'. It presented criticisms and future possibilities for ethnomathematics. The discussions in the handbook was reviewed by the author. Ethnomathematics was criticized from the 1990s to 2000. The main criticism was that it did not lead to universal mathematics because of its cultural peculiarities (Pais, A., 2011). In response to these criticisms, it was pointed out that learning mathematics should begin with the student's social context, reality, and interests, and context-independent mathematical activities should not be forced. The main aspect of ethnomathematics is not about understanding alternative mathematical systems, but about deepening the understanding of the importance and role of mathematics in society (Rosa and Orey, 2013). Albanese and Perales (2015) noted that the recognition of mathematics from an ethical perspective in cultural practices can serve as a theoretical framework for ethnomathematics. Focusing on community-specific mathematical activities in daily life ultimately frees each ethnic group from discrimination, inequality, and prejudice. In other words, it can be said that ethnomathematics also has such a role to play and is closely related to “equity.” This way of thinking encourages the study and practice of ethnomathematics. For example, UNESCO (2012a) stated that ethnomathematics can support the understanding of the ethnic group, consideration for diversity, avoidance of exclusion and isolation, and student understanding of human activities related to mathematics. Rosa and Gavarrete (2016) argued that ethnomathematics perspectives should be incorporated into the mathematics curriculum for students to change their attitudes toward their cultural backgrounds. In the age of globalization, they see the importance of ethnomathematics from a local perspective of re-recognizing and inheriting one’s own culture. Rosa and Orey (2015) proposed the use of ethnomathematics to enhance the sense of enjoyment and creativity in mathematics as ethnomathematics helps build metacognition of mathematical knowledge in sociocultural contexts. They linked ethnomathematics with creativity and metacognition, which are touted as OECD key competencies and 21st century skills of the AOTs necessary to live in the world of the future. Ethnomathematics is an important component in the sociocultural aspect of mathematics curricula, and research on this is ongoing. It has been criticized for not being connected to academic mathematics owing to its cultural peculiarities and the difficulty of teaching in the classroom. Overcoming these criticisms, recent practice and research have

focused on other sociocultural components. The role of ethnomathematics at the school level has both changed and produced changes such as those in attitudes toward one's own culture, awareness of multicultural diversity, the establishment of metacognition of mathematical knowledge in sociocultural contexts, and increased creativity in mathematics.

2.6.4 Globalization: Influence on the sociocultural aspect

"Globalization" influences the sociocultural aspect of mathematics curricula and is related to discussions and policies on "equity," "linguistics," and "ethnomathematics," which this study focuses on. It is one of the components that were specifically taken up in the sociocultural model of mathematics education by Khoon et al, which we referred to while defining the sociocultural aspect. However, as is clear from the meta-analysis of previous studies in Chapter 2, the number of research articles on this component is small when compared to those on other components. This may be because globalization is one of the sociocultural components that influences the others. Major studies include international large-scale assessments such as PISA and TIMSS, abilities to be acquired such as OECD key competencies, and their impact on education policies in each country. "Globalization" is discussed with a focus on two points: the international large-scale assessment, and competencies stipulated by international organizations and economically-advanced nations.

Universal Primary Education (UPE) was established by the UNESCO Regional Assembly in the 1960s with a target year of 1980 (Sawamura, 2004). At EFA, which was held in Jomtien, Thailand in 1990, a universal international development package comprising six goals was adopted as EFA. EFA was an opportunity for countries with different societies and cultures to build common goals. Global goals and indicators were set, which each country had to pursue in its own way, and the means to achieve them varied from country to country. In other words, this was not "internationalization," but "globalization."

The international large-scale assessment tools such as TIMSS and PISA may have triggered the awareness of "globalization." Research on international comparative analyses of survey results and the philosophy and purpose of TIMSS and PISA, have been carried out since the 1990s. TIMSS and PISA have made it possible to compare diverse educational systems that do not lend themselves to direct comparison by placing them in a homogenized measurement space (Gorur, 2016). The phenomenon whereby such an international large-scale assessments affects the educational goals of each country and is being attempted to unify the mathematics curriculum of each country, is not internationalization but globalization. TIMSS is an international scale of achievements in mathematics and science

for students in Grade 4 of elementary school and Grade 2 of junior high school. It has been implemented every 4 years since 1995 by the International Association for the Evaluation of Educational Achievement (IEA) to clarify the relationship between the achievements and the learning environment for students. PISA is primarily aimed at children aged 15 years in OECD countries, and assesses the extent to which knowledge and skills acquired at the end of compulsory education can be applied to various challenges in real life. It investigates reading comprehension and mathematical and scientific literacy (Schleicher, 2018). TIMSS and PISA attempt to measure conventional academic ability and a new view of academic ability, respectively (Fujita, 2005). In 2013, "PISA for Development" began, with a focus on the participation of developing nations. Addey and Sellar (2017) cited the following seven main motives for developing countries to participate in such international large-scale assessments: (1) For evidence of policy-making, (2) To learn test techniques such as psychological measurement, and utilize them for domestic academic ability tests, (3) To receive international assistance and support, (4) To improve international relations, (5) To respond to domestic political dynamics, (6) For economic growth, and (7) For improving curriculum and practice. Of these, (3) and (4) are peculiar to developing countries. With respect to (3), it is presumed that international financial support in the field of education may be conditional on participation in an international large-scale assessments such as PISA. With respect to (4), Takayama (2018) pointed out that there is silent pressure to participate in an international student assessment in order to be recognized as a formal member of the international community, that is, participation in PISA has a "ritual" meaning that shows affiliation and loyalty to the global community. The original purpose of these academic assessment tests was to shift the focus of policymakers on national education policies from looking upward in the bureaucracy to looking outward for the next generation of teachers and schools, and not just to conduct a comparison of results between countries (Schleicher, 2018). The original purpose of the survey was to objectively grasp the state of education in the country and utilize it in education policy. One of the purposes was to eliminate political influences on education policy and to pay attention to the situation in a classroom. However, in reality, it is moving in a different direction from the intended purpose. This shift has drawn criticism. By analyzing the criticisms, the impact of international large-scale assessments on the globalization of the mathematics curriculum, and their relationship with the intrinsic nature of curriculum development are discussed.

The first criticism, is against the idea of these international large-scale assessments, and this criticism is also closely related to the sociocultural aspect of mathematics curriculum

development. Keitel and Kilpatrick (1999) noted that TIMSS is dominated by the US, which provides financial support for data collection and analysis, and argued that there was a risk of distorting the education policy of the country while analyzing the status of education in the country with such tests. Many countries have justified educational reforms based on the results of PISA since 2000 (e.g., Figazzolo, 2009). The OECD, the implementing agency of PISA, has also pointed out that PISA-type capabilities have been explicitly incorporated and emphasized in the revised curricula and standards of many countries, as PISA influences national education policies and has acknowledged this situation (OECD, 2012). In PISA, literacy is structured based not very much on what is important as educational content, but on what is globally common and enables international comparison and policy-borrowing (Schleicher, 2018). This mode of thinking ignores the sociocultural aspect of each country. Educational researchers and practitioners display concern about the negative effects of measuring the great diversity of educational traditions and cultures by a single, viewpoint-based standard (Meyer, Heinz-Dieter, et al., 2014). They accused the OECD of "educational colonialism." Cai and Howson (2013) pointed out that the uniqueness of the mathematics curriculum of each country is at risk under the influence of TIMSS and PISA.

PISA does not rely on the school curriculum because: (a) In the information age, the ability to apply knowledge to various situations and challenges in society is more important than knowledge itself, (b) Relying on the school curriculum implies a limitation on components that are common among participating countries, which makes it difficult to learn from the education systems of other countries, and (c) Extensive and versatile skills that should be acquired across countries and cultures are evaluated (National Institute for Educational Policy Research: hereafter NIER, 2013, p.60). In PISA, literacy is structured based on what is globally common and enables international comparison and policy-borrowing, rather than mere important educational content (Matsushita, 2014). If so, these must be considered to have a very broad generality. However, the phrases in PISA's mathematical literacy, "current and future personal life, professional life, social life with friends, family and relatives, and constructive, concerned and reflective citizens(OECD, 2013, p.17)" are closely related to the context of the personal living environment and can be said to have contextual dependence. These contradictions drew criticism from many educational researchers and practitioners. The second criticism is related to society and ideology. For example, when the PISA rank goes down, public opinion reacts only to the low rank, which changes the ideology of education and has an impact on education policy. Conversely, a good PISA rank may reassure people, and not evoke any discussions on

essential issues concerning education nor create any sense of crisis around the education policy. The influence of an international large-scale assessments on public education in the world is large. All over the countries are affected and mathematics curricula have become more similar worldwide. This is also in line with the definition of globalization that "everything goes beyond the framework of a country and becomes universal."

Along with international large-scale assessments, the ability-related goals set by international organizations and economically-advanced countries influence the globalization of mathematics education. Matsushita (2010) described these as concepts related to abilities that have become common educational goals in many economically-advanced nations, mostly grouped into three to five categories, and the structure is such that several components fit each category. The NIER (2013) categorized the competencies defined by educational reforms based on global competencies into three categories: *basic literacy*, which deals with language, numbers, and information; *higher cognitive skills*, which are centered on thinking ability and learning; and *social skills*, which autonomously connect relationships with society and others (Table 12).

Table 12. Competencies stipulated in major organizations, countries, and regions

	DeSeCo	EU	Australia	USA	ECA
Basic Literacy and Numeracy	Using tools interactively - Use language, symbols, and texts interactively - Use knowledge and information interactively - Use technology interactively	- Communication in the mother tongue - Communication in foreign languages - Mathematical competence and basic competencies in science and technology - Digital competence	- Literacy - Numeracy - ICT and technology	- Information literacy - ICT literacy	- Mathematical competence - ICT, science, and technology competence
Higher Cognitive Skills	Reflectiveness - Metacognitive skills (thinking about thinking) - Creative abilities and taking a critical stance	Learning to learn	Critical and creative thinking	- Creation and innovation - Critical thinking and problem-solving - Learning to learn - Collaboration	- Critical and creative thinking - Learning to learn
Social Skills	Acting Autonomously - Acting within the big picture - Forming and conducting life plans - Defending and asserting rights, interests, limits, and needs - Interacting in heterogeneous groups - Relating well to others - Co-operating and working in teams - Managing and resolving conflicts	- Sense of initiative and entrepreneurship - Social and civic competencies - Cultural awareness and expression	- Ethical behavior - Personal and social skills - Intercultural understanding	- Career and life - Personal and social responsibility - Citizenship - Communication	- Personal and social skills - Recognition of your own and other people's culture - Communication

Source: Updated NIER (2013) by the author

The competencies classified as basic literacy and numeracy in addition to content that has been learned as part of mathematics so far is related to the utilization of ICT and information. All countries and institutions consider problem-solving and critical thinking higher cognitive skills. The East African Community, Australia, and the US also define metacognitive abilities such as "learning how to learn" as competencies. For the two categories of basic literacy and higher-order cognitive skills, the competencies are the same regardless of the institution or country. These are global competencies that are essential for

one to live in society both now and in the future regardless of where they are in the increasingly globalized world.

In addition to the international large-scale assessments like PISA and TIMSS, the views of competence may influence the globalization of mathematics education. As social and economic globalization progresses, it is necessary to develop competencies that can be used globally in school education. Therefore, as the above competencies are presented, other countries will tend to follow, and as a result, the globalization of education is promoted. This is strengthened in developing nations because of the lack of specialists who can appropriately analyze their educational situation and problems. In addition, this problem is exacerbated by the lack of specialists who will be able to recognize the shortcomings of educational borrowing.

International large-scale assessments, they have a great influence on the educational purpose, content, and method in each country. There has been a lively ongoing debate on these from the 1990s to the present, and in recent years, there have been critical discussions and warnings from researchers and educational practitioners. The main reason for this is the sense of crisis that the sociocultural aspect of one's country in mathematics education is being neglected.

The characteristics of each component are summarized chronologically in Figure 5. The issues related to equity and ethnomathematics have been discussed since the 1980s. The pace of globalization has increased since the 1990s, mainly due to the rapid growth in technology and communication. The policies on linguistics has diversified. Thus, the range of policy on equity and ethnomathematics has also broadened. The key points in this discussion are summarized in Figure 6.

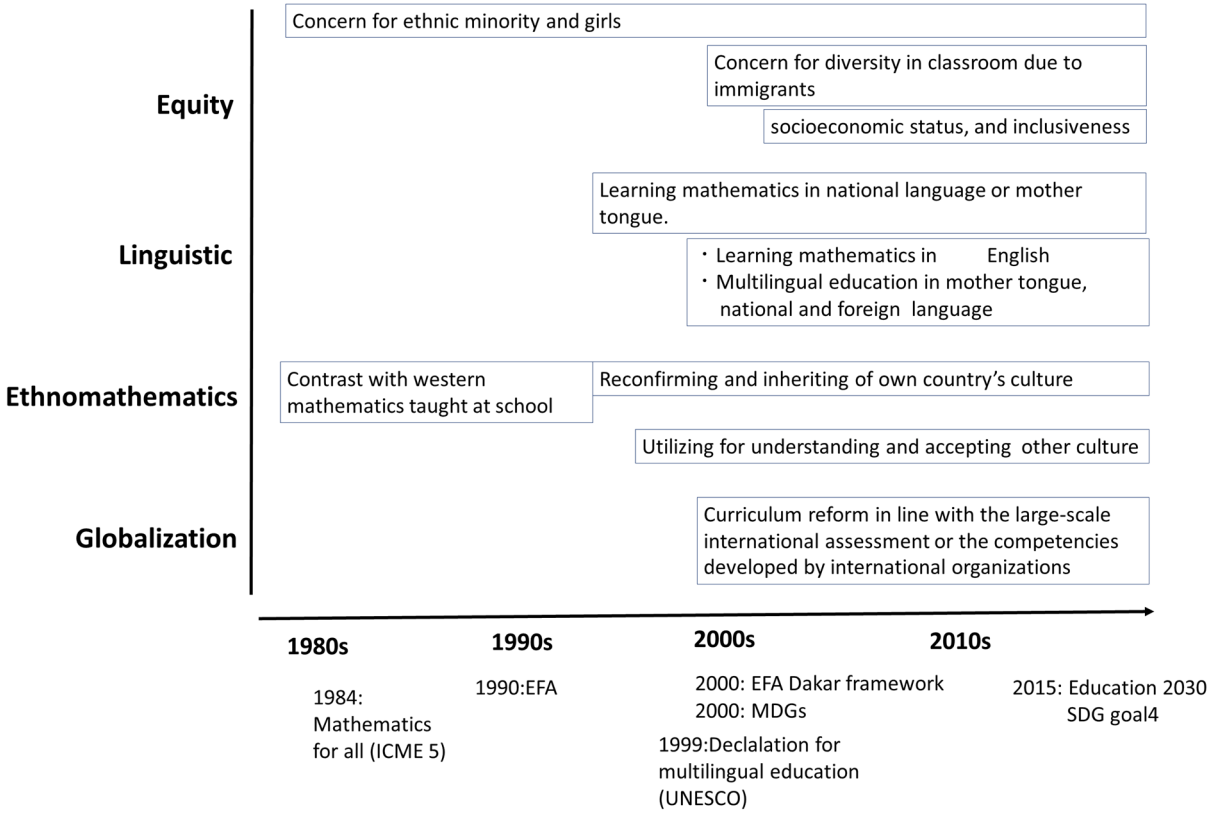


Figure 5. Global discourse on the four sociocultural components

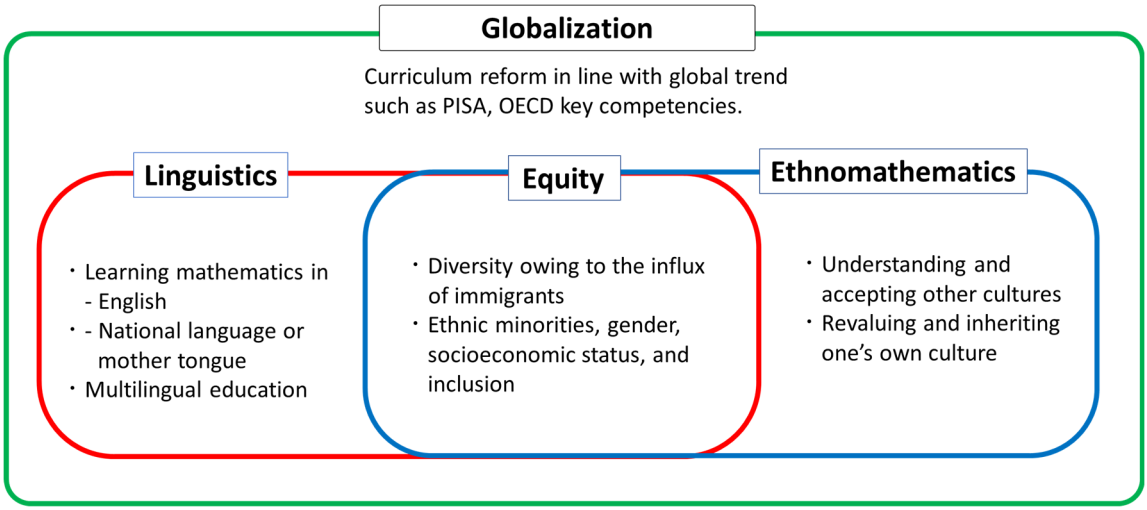


Figure 6. Relationships among the four sociocultural components in global discourses

2.7 Summary of Chapter 2

In this chapter, the author first presented an overview of the changing trends in curriculum development in developing countries right from their independence to recent times. In addition, the author also showcased educational borrowing, which is why the sociocultural aspect was not considered while developing curricula. Furthermore, the author examined how curriculum development and revision were carried out based on the educational borrowing model. Many sub-Saharan African countries have implemented curriculum revisions since the 1990s. Curricula of developed countries were copied because of the lack of experts who could accurately grasp and discuss the domestic educational situation and pressure from donors. However, developing countries have begun to establish educational systems in line with the quantitative expansion of education since 2000, and the curriculum has been revised based on independently accumulated data and experience in education. The challenges stemmed from the difficulty they faced in internalizing the borrowed curriculum while following global trends. Second, the theory underlying the sociocultural aspect of mathematics education was first discussed based on the five levels of mathematics education shared in Bishop (1991), and the sociocultural model in mathematics education presented in Khoon et al. (2010). As a result of the discussion, the sociocultural aspect can thus be defined as the integration of the cultural aspect that is formed and rooted in the country and the social aspect that is shaped based on the cultural aspect. Therefore, we call them the sociocultural aspect of the mathematics curriculum as a whole. In addition, the specific items constituting the sociocultural aspect are called components.

Third, the sociocultural components to be discussed specifically based on the provisions of the sociocultural aspect were examined. Four components, namely “linguistic,” “equity,” “ethnomathematics,” and “globalization,” were derived. By meta-analyzing two journals, ESM and JRME, research trends from the 1980s to the present were identified. These components are not independent, but are inter-related. “Equity,” which education aims to achieve, comprises “linguistics,” which is a means, “ethnomathematics,” which refers to content, and “globalization,” which affects all components of the sociocultural aspect.

Finally, the author examined the global discourse on the four components (equity, linguistics, ethnomathematics, and globalization) that constitute the sociocultural aspect of mathematics curriculum, and clarified the relationship among them.

CHAPTER 3
METHODOLOGY

As described in Chapter 1, Mozambique was chosen as a case study. In analyzing the mathematics curriculum development in Mozambique relating to the conceptual framework presented in the literature review, it is necessary to clarify the subjects and methods of analysis. This chapter explains the methodology used in this study. To clarify the sociocultural aspect of mathematics curriculum, it is indispensable to analyze not only the curriculum as a product but also the process of the curriculum revision such as the discussions implemented for the revision and the materials used for the revision. The method of analysis used for the curriculum (product) is presented first, followed by that for the curriculum development (process).

3.1 Method of analysis for the curriculum (product)

3.1.1 Target and focus

The author relied on Baba (2010) for a structural understanding of the intended curriculum. According to the Global Association for the Evaluation of Educational Achievement (IEA), which is the implementing body of TIMSS, the intended curriculum is mathematics and science content determined at the level of the national or educational system and is outlined in educational policies and regulations, the content of national examinations, textbooks, instruction books, etc. as concepts, methods, attitudes, etc. of mathematics and science (Mullis et al., 2012). In other words, the intended curriculum comprises educational programs, content, and methods, etc., set by the country. Baba (2010) captured the intended curriculum in a structural manner and classified it into three layers: a big structure, a middle structure, and a small structure (Table 13). The big structure comprises the educational system of the country such as the educational stages, subjects, and grades. The middle structure comprises the relationship between units that captures the cohesiveness of the educational content. The small structure refers to the structures within each unit. The topics covered by each structure are described thus: the big structure covers educational regulations and policies, the middle structure covers the syllabus that describes the learning content of mathematics education, and the small structure covers textbooks.

Table 13. Structure of the intended curriculum (Baba, 2010)

Structure	Content
Big Structure (Basic structure)	Educational stage, subject, and grade: This covers the educational stage and subjects such as the primary, lower and upper secondary education levels, among other things. Most countries have introduced grade systems, but there are some that have structures that merge several grades like Australia and the US.
Middle Structure (Inter-Unit Relations)	Domains and relationships among units: This comprises educational content. There are cases where 'Unit' appears directly on the syllabus or it does not so. When it does not, it is expressed in more spreading expression, and more than one unit are enclosed in it, and a strong relationship among them are suggested. It is called the domain.
Small Structure (Intra-Unit Relations)	Intra-Unit: A structure that effectively arranges concepts, ideas, calculation methods, etc., are dealt within units. They are not directly written into the curriculum. Textbook writers and developers of teaching materials decide what to include based on the philosophy and purpose of the curriculum.

Source: Baba (2010)

The analytical framework for this study was developed by revising the structure shown in Table 14. Baba (2010) developed the framework, focusing on the structure. The aim of this study was to analyze the sociocultural aspect of the intended mathematics curriculum. Thus, the categories of the framework, big, middle, and small, were directly adapted. A structure can be observed among the categories; big, middle and small. Policy documents are applied as the big structure. Curriculum document and syllabus are developed based on these documents as the middle structure, and then textbooks and supplementary materials are developed as the small structure. The intended mathematics curriculum is gradually embodied and becomes specific in big, middle and small, from the policy level to the syllabus and then to the textbook. It is possible to capture the details of the sociocultural aspect of the intended mathematics curriculum by capturing structurally the sociocultural aspect presented in each and analyzing their connections. Furthermore, this analysis takes the work of Bishop (1991) and Khoon et al. (2010) one step further, as explained in the research gap. It makes the previous studies on sociocultural aspects more concrete and closer to the practical use in actual curriculum analysis. On the other hand, structure in each category (big, middle and small) is not considered. the content and focus of the analysis were newly set in each category.

Policy documents that describe the national educational strategy were analyzed as part of the big structure. The objectives of education and the role of mathematics education

change based on the educational direction of the country. The "objectives of mathematics education" described in the mathematics syllabus are included within the big structure even though the phrases that explain the educational content in the syllabus were analyzed as part of the middle structure. The textbooks were analyzed as part of the small structure.

The big structure analysis focused on both the general vision and the specific vision for mathematics education. The middle structure analysis focused on the structure of the syllabus and the scope and sequence of the learning content. As teaching policies such as being child-centered and adopting problem-solving approaches are related to the four sociocultural components, they were extracted and discussed if there were any descriptions on them. For the small structure analysis, which served as a starting point for a detailed analysis of the sociocultural components, the situational setting of the problems and exercises assigned as part of mathematics education vis-à-vis the real-world were examined. Next, the analysis focused on the photographs, pictures, and figures used. These analyses focus on the sociocultural components extracted in Chapter 2. The big structure analysis focuses on the direction of education in Mozambique and why it was set, as well as the value and significance of mathematics education. A deep analysis of the four sociocultural components becomes possible by analyzing the above three structures and the associations among them.

Table 14. Analytical framework of the intended mathematics curriculum in this study

	Material analyzed	Focus of analysis
Big	- Written educational policy documents (published from 1990 onward) - Objectives of mathematics education in the syllabus (1984, 2004, and 2015)	- Educational vision and its rationale - Objective of mathematics education and its rationale
Middle	- Primary mathematics syllabus (1984, 2004, and 2015; structure of the syllabus and learning content)	- Structure of the mathematics syllabus - Learning content and their sequence
Small	- Textbook (2004 and 2015, Grade 3 textbook)	- Percentage of problems related to the real-world (Kusaka,2020a) - Problem setting related to the real-world (Nagasaki, 2000) - Photos, diagrams, and pictures used for the settings (An & Hao, 2011)

Source: developed by author

3.1.2 Methodology used in each structure

This section presents the methodology used to examine the structures defined in previous section.

(1) Analysis of the big structure

Document analysis was carried out to examine the national education policy and the objectives of mathematics education. Sentences, phrases, and words that were directly related to the four sociocultural components and the content that highlighted their background in the national educational policies were extracted. Taking into consideration their reliability, they are systematically extracted and analysed in the form of text mining. They were examined in relation to the country's vision for education and the explanations offered for why they were set. The content related to the four sociocultural components among the objectives of mathematics education were extracted and analyzed in the same way. Furthermore, because it becomes possible to discuss the sociocultural components in more depth by associating them with the value of mathematics education in the country and the significance of learning mathematics, Nakahara's (2008) principles regarding the objectives of mathematics education, namely "humanism," "pragmatism," and "culturalism." Humanism calls for the development of human beings by building character, forming various abilities, and developing will through mathematics. Pragmatism focuses on practicality and requires mathematics to be useful for one's everyday life, occupation, social development. Culturalism aims to teach, pass on, and develop mathematics. These principles are not exclusive and can be pursued individually or in combination. This classification makes it possible to discuss the value of mathematics education and the significance of learning mathematics in relation to the four sociocultural components focused on in this study.

(2) Analysis of the middle structure

The structure of the mathematics syllabus and the educational content and their arrangement were analyzed as part of the middle structure. The learning content and its quantity are related to ethnomathematics (equity in educational content), which is one of the four sociocultural components. Furthermore, it is possible to analyse in relation to globalization and equity by considering how the learning content is affected by globalization as well as the intention to revise them.

(3) Analysis of the small structure

Textbooks, which are the focus of small structure analysis, also embody the big and middle structures and serve as a link between the intended and implemented curricula. The four sociocultural components are most apparent in textbooks. As of 2020, INDE was developing a primary mathematics textbook corresponding to the 2015 curriculum for students from Grade 1 onward, in phases. The textbooks for the 2004 curriculum were published by a private company, whereas those on the 2015 curriculum were the first national textbooks in Mozambique. As of 2020, the development and distribution of textbooks up to Grade 3 had been completed. As it is deemed appropriate to spend more time on problem-solving (social and cultural components) related to concepts, the higher the grade level, the more likely the sociocultural aspect will be taken into consideration (Bishop, 1991). Therefore, the textbooks for Grade 3, which is the highest grade for which textbooks had been developed at the time of study, constituted the subject of analysis. *Eu Guido de Matematica 3* published by Plural Editores was used as the textbook corresponding to the 2004 curriculum (Chissaque and Dias, 2005), and *O Mundo da Matematica*, which is the national textbook, was used as the textbook corresponding to the 2015 curriculum (Fumo et al., 2016, 2017).

The analysis of textbooks in the small structure focused on the three things indicated in the analytical framework. First, the percentage of problems related to the real-world was analyzed. The reason is that, if the majority of problems are just asking for mathematical operations and definitions without context, it can be said that the sociocultural aspect is not considered. Therefore, as a first step, it is necessary to examine the proportion of problems related to the real-world. Second, the problem situations associated with the real-world are classified and discussed. This consideration is directly linked to the four components of the sociocultural aspect. For example, analyzing the context and extent of the problems related to communities, the whole country, other countries, and the world can be related to the components of ethnomathematics, globalization, and equity. Third, analysing photos, diagrams, and pictures used for the settings, An and Hao (2011) pointed out that diagrams and pictures in textbooks represent the sociocultural aspect. The analysis of the diagrams and pictures can supplement the analysis of the context of problem settings, and it allows a further analysis of how the four components appear in the textbooks.

1) Problems pertaining to real-world scenarios

Kusaka (2020a) compared the textbooks of Japan and Mozambique by focusing on the

"percentage of problems related to the real-world," "problem situations related to the real-world," and "content of photographs, pictures, and figures used in textbooks," and clarified the characteristics of the sociocultural aspect in the textbooks of both countries. This study followed the same method. In terms of textbook composition, if the objective was for introductions to construct meaning, then the problems related to the real-world are used in the introduction, followed by exercises for mastering the calculation of algorithms. In the case where the focus is on mastering the calculation of algorithms, first, the algorithms are introduced and the exercises after the introduction related to the real-world are positioned as tasks to build application skills in those algorithms.

Consequently, the analysis was conducted by separating the problems of introducing new learning topics and other exercises.

2) Problem situations pertaining to the real-world

First, it is necessary to clarify the problem situations pertaining to the real-world. These results provide criteria for determining the extent of sociocultural aspects appearing in mathematics textbooks. For word problems and other problems and tasks, those whose contexts and situations generally exist in the real-world are defined as problems pertaining to the real-world. As problems such as "How many multiples of 2 are there between 1 and 100?" exist in a context, but do not relate to the real-world, they were not included within the scope of problems related to the real-world. Second, a specific analysis method was examined. For example, Nagasaki (2000) examined specific real-world and real-life situations in teaching materials, and classified them as follows: "a. Family life, b. School life, c. Social life, d. Transportation, e. Industry, f. Natural science, g. Social science, h. Home, i. Technology, j. Sports, k. Art, l. Games, m. Puzzles, n. Play, o. History of mathematics, p. International understanding, q. Information, r. Environment, and s. Welfare health." As shown in Table 15, 121 items were listed as specific examples of each situation. The problem situation was the starting point for the in-depth analysis of the four sociocultural components, especially equity, globalization, and ethnomathematics. For example, the amount of the problem situation related to the local community, other countries or African countries, as well as their specific content, were analyzed. The problem situations in textbooks were classified based on above mentioned classifications. However, given that Nagasaki's study was conducted more than 15 years ago and focused on the Japanese context, it was expected that there would be situations in this study that would not fit into the classifications. Thus, new situations were added to classify them.

Table 15. Classification of problem setting related to mathematics and society/culture

A. Family life	A01. House (building) A02. Garden · Field A03. Commuting A4. Furniture, Interior decoration A 05. Food A 06. Meal A 07. Meals Cooking utensil A 08 Household goods A 09. Communication A 10. Leisure A 11. Newspaper A 12. Travel, Adventure A13. Family A14. Home address A15. Shopping A16 Family finance
B. School life	B01. School activities B02. Class activity B03. Study B04. Physical examination/ physical abilityB05. School lunch B06. Sports festival B07. Excursion B08. Results of study B09. Classroom structure · Schoolyard B10. School and class environment B11. School supplies
C. Social life	C01. Weather C02. Paper C03. Land C04. Building C05. Vending machine C06. Post C07. Walking C08. Lottery C09. Money C10. Game C11. Calendar C12. Water C13. Time capsule
D. Traffic	D01. Road D02. Train D03. Automobile D04. Fire engine D05. Airplane D06. Taxi
E. Industry	E01. Carpenter E02. Metal ware E03. Drafting E04. Products
F. Natural science	F01. Earth F02. Space F03. Climate F04. Earthquake F05. Sound F06. Animals F07. Plant F08. MicroorganismF09. Acid · Alkaline F10. Atom F11.Electricity F12. Scale F13. Light F14. Pendulum F15.Gear F16. Gas / liquid / solid F17 string F18 tube F19 radio
G. Social science	G01.Geography of Japan, G02.Geography of the world, G03.Population, G04.Map, G05.Economy, G06.Election, G07.Tax
H. Home	H01.Nutrition H02Clothes
I. Technology	I01.Copier, I02.Record, I03.Camera · Video camera, I03.Television, I03Fluorescent lamp, I04Antenna, I05Cannon, I06.Space shuttle, I08.Telescope, I09Flashlight
J. Sport	J01 Number of games J02 Baseball J03 Soccer J04 Golf J05 Olympic Games J06 Ski
K. Art	Music, Art /Drawing and manual arts
L. Game	Game, Cards, Gambling, Shogi
M. Puzzle	M01 Number Puzzle M02 Puzzle on shape
N. Play	N01 Origami N02 Indoor play N03 Outside play N04 Amusement park
O. Math history	O01 Mathematician of Japan O002Mathematical history of Japan O003 Mathematician of the world O004 Mathematical history of the world
P. International understanding	Culture in various countries
Q. Information	Cipher, Computer
R.Environment	R01 garbage R02 Lake · Dam Wood, River, Ocean
S.Welfare health	S01. Human, S02 Braille S03 Aging

Source: Extracted from Nagassaki (2000)

3) Content of photographs, pictures, and figures used in textbooks

Nakahara (1995) called the graphical expressions "expression by way of figures, pictures, graphs, etc.," and identified imagery as one of its characteristics. An and Hao (2011) pointed out that diagrams and pictures in textbooks represent the sociocultural aspect. All pictures and photographs were extracted from the textbooks and analyzed in connection with the four sociocultural components.

3.2 Method of analysis of the revision of the mathematics curriculum

(1) Framework for analysis

In analysing the mathematics curriculum revision process, the analytical framework was developed based on the educational borrowing theory described in Chapter 2 (Table 16). This was because the situation of curriculum borrowing in the curriculum development process and Mozambique's initiatives, were both related to the sociocultural components of the mathematics curriculum, which constitute the focus of this study. It made it possible to analyze the curriculum deeply. The main focus here was on the first and second stages of educational borrowing, namely "cross-national attraction" and "decisions," respectively. The material used during the curriculum revision process, such as a result of a national survey, policy documents, and so on, was analyzed. In addition, the content of the discussions during the curriculum revision process was also analyzed. The extent of their ownership was discussed based on the spectrum of educational transfer. The combined consideration of these items supported the analysis of the curriculum (product) mentioned in previous section.

. Table 16. Framework for the analysis of the curriculum revision process

Stages in educational borrowing (Stages 1 and 2 alone)	Materials relied on	Focus of analysis
1. Cross-national attraction	- Materials used in the curriculum revision process - Discussions conducted during the curriculum revision process	- The kind of evidence used. - Consideration of international trends and Mozambique's situation - Analysis of their initiative through the spectrum of educational transfer. 1.Imposed, 2. Required under constraint, 3. Negotiated under constraint, 4. Borrowed purposely, and 5. Introduce under influence
2. Decision		

(2) Steps in the analysis

A document analysis of the primary mathematics curriculum and the material consulted during the revision process was conducted. A Mathematics Technical Officer at the INDE, was interviewed on November 11, 2018. On November 21, 2018, the Director of the INDE and Chairperson of the 2015 curricular revision, was interviewed. They were interviewed separately to check whether there were any discrepancies in the materials used and the content of discussion in the revision process and to consolidate both their views.

I chose one technical officer and chairperson of the 2015 curricular revision. The author asked two questions to clarify the curriculum revision process and the material used: “What process was followed for curriculum revision?” and “What material was referred to in the course of revising the curriculum?” Further, the author asked six questions to clarify the background (decision-making, initiative, and so on) of the curriculum revision process and INDE's idea for mathematics education in Mozambique. The interview data are categorized as follows: the process of curriculum revision, materials and documents used for the revision, and discussion content in the revision process.

The analysis proceeded as follows.

1) As a prerequisite, the 2015 curriculum revision process was clarified by comparing the big and middle structures of the 2004 and 2015 curricula.
2) Through the interviews, the process of curriculum revision in Mozambique and the material used therein were identified.
3) The materials cited during the revision process were analyzed.
4) Through the interviews, issues at each stage in the revision process were categorized.
5) The results obtained under items 1 to 4 were discussed. Through the discussion, factors informing the curriculum revision process were identified and analyzed.

3.3 Methodological rigor in the research

As this is a qualitative research study, the research methodology was developed with maximum consideration for the reliability of the results. First, all documents analysed in this study, which are summarized in the analytical framework section of the study (Table 14), were limited to the Mozambican Government, Ministry of Education, or international organizations to ensure their validity. Reliability was also ensured as sentences and phrases related to the four sociocultural components were systematically extracted and analysed in the form of text mining. Furthermore, the textbook analysis in the small structure was

conducted systematically using the method for classifying real-world and non-real-world problems (Kusaka, 2020a) and the method for classifying problem situations (Nagasaki, 2000).

Second, for the analysis of the curriculum revision process, two members involved in the curriculum revision were interviewed separately. Furthermore, the authenticity of the content in the triangulation was checked by reviewing the actual transcript of the interviews. The curriculum revision process and any discrepancies in the materials used in the revision process were checked.

Third, confirmation of the interview results and analysis was obtained from the interviewees in a different day through e-mail. The series of analysis were compiled into a paper along with the director of INDE, the bureau responsible for curriculum development, and were published.

3.4 Summary of Chapter 3

In this chapter, the method relied on to analyze mathematics curriculum development was presented. Regarding the product, the author developed an analytical framework by drawing from Baba's (2010) mathematics curriculum. The framework clarified the material required for analysis and the focal points for the intended curriculum. Documents pertaining to the national education policy and the aims of mathematics education were analyzed as a part of the big structure. The mathematics syllabus was analyzed as a part of the middle structure. The textbooks were analyzed as part of the small structure. The method was implemented with a focus on the four sociocultural components. An analytical framework was developed based on the educational borrowing theory to examine the process. The analytical perspective and evidence were set at each stage of educational borrowing. Through the analysis of the process based on interviews with those involved in it, the sociocultural aspect that could not be understood from the product alone was derived.

CHAPTER 4
CASE STUDY OF MOZAMBIQUE'S MATHEMATICS CURRICULUM DEVELOPMENT

This chapter presents the analysis result of mathematics curriculum development using the method presented in Chapter 3. Section 1 presents Mozambique's educational history. Section 2 presents the analysis result of the three primary mathematics curricula since Mozambique's independence. Section 3 shows the analysis result of 2015 curriculum revision process in detail.

4.1 Mozambique's educational history

Mozambique had a mixed and diverse culture even before the advent of Portuguese rule. The country has been developed as a trading base for the Arabs, Indians, Persians, and Chinese. Mozambique is a multi-ethnic nation with about 40 ethnic groups. However, over 70% of the people feel a sense of belonging to the nation, rather than to their tribes. This may be because of the poverty caused by the civil war that took place between 1977 and 1992, which hampered the traditional mutual aid system among ethnic communities, and people's lives were supported by the state instead of by their ethnic communities (Schindler, 2013). These aspects seem unique to Mozambique and are not evident in other African countries.

Table 17 summarizes the history of Mozambique's educational curriculum. During Portuguese colonial rule, the Portuguese primary mathematics curriculum was used. Three revisions were made since independence in 1975. In the 2004 revision, adapting to the needs of the region was considered a priority. The results of the Southern and Eastern Africa Consortium for Monitoring Educational Quality (SACMEQ) survey had a significant impact on the 2015 revision. Mozambique is a typical country that used the colonial curriculum before independence and revised it thrice since independence in keeping with the trends in each era. Although the official language is Portuguese, it is a multilingual nation with over 20 Bantu languages being spoken on a daily basis. Even though only about 6% of the population speaks Portuguese as its mother tongue, the number of speakers of Portuguese as a second language has risen to about 40% because of governmental efforts (Matsugaki, Kozai, & Ishizaka, 2015). It is similar to other African countries in that each tribe has its own language. Mozambique has commonalities, and peculiarities that distinguish it from

other African countries. Therefore, the results and analysis can be interpreted according to commonalities and peculiarities.

Table 17. Transitions in the mathematics curriculum in Mozambique

Until 1983	・Portuguese mathematics curricula were used in the colonial era (Gerdes, 1981). ・Portuguese system remained in place until 1983 (Woolman,2001)
Revision in 1984	The first national system of education was introduced, whereby the seven-year compulsory schooling rule was put in practice. (Gerdes,1986)
Revision in 2004	Mozambique implemented a new basic education curriculum that was suited to local needs; 20% of this curriculum was designed by the schools and communities themselves (Alderuccio, 2010; Chachuaio & Dhorsan, 2008)
Revision in 2015	Drawing from the results of the 2007 SACMEQ study, the "Education Strategic Plan 2012-2016" mentioned the following: "Continue with the curriculum review taking into account the strengthening of literacy and numeracy and also the ensuring a better connect between lower and upper Primary Education" (MINED, 2012, p.30)

Source: Excerpts from Kusaka (2018)

4.2 Analysis of the mathematics curriculum development

4.2.1 Policy document and objectives of mathematics education (Big Structure)

This section analyzes the national educational policies and objectives of mathematics education.

(1) Analysis of Policy documents

UNESCO (2002b) compiled a list of the main reports and planning documents issued by the Ministry of Education and Human Development of Mozambique (A Ministra da Educação e Desenvolvimento Humano: MINED) and the National Institute of Education and Development (Instituto Nacional do Desenvolvimento da Educação: INDE). For the period between 1990 and 1998, the documents on that list were analyzed. Since 1998, the national education strategic plans and action plans explained the direction and strategy of education in Mozambique. Therefore, these documents were used for analysis from 1998 onwards. The author read and summarized the content in relation to the four sociocultural components (Table 18). The Educational Strategic Plan issued in 2012 was originally meant to be in force until 2016, and was subsequently extended to 2019. This has had the greatest impact on

education in Mozambique in recent years. Therefore, as an example, this educational strategic plan was specifically taken and phrases were extracted relating to the four sociocultural components for analysis. Table 19 presents the sociocultural aspect described in the national Educational Strategic Plan issued in 2012.

Table 18. Policy documents and reports related to public education

Report	Year	Publisher	Content
Education in Mozambique: Problems and perspectives.	1990	MINED	• Low enrolment, high dropout, and low completion rates were identified as problems.
Education for All: Mozambique: A Strategy	1992	MINED	• Report on the Policy for EFA. • The need for curriculum reforms in primary education as part of EFA, especially the promotion of the decentralization of education, and the importance of community participation in education were emphasized.
Basic education in Mozambique: Present situation and prospects	1996	MINED	• Competency-based learning develops the skills necessary to solve basic problems pertaining to health, food, housing, technology for the production of animals and plants, and many other kinds of content specific to each community.
Final report on bilingual education: Results of the external evaluation of the experiment on bilingual education in Mozambique	1997	INDE	• Reports on bilingual education pilot projects. • Schools that used both Portuguese and local languages reduced the children's dropout rates, increased the enrolment rates among girls, and improved the ability to think and express themselves in class.
Strategic education plan, 1999–2003: Fighting exclusion, renewing the school system	1998	MINED	• UPE is most important in achieving the national development goals such as economic growth and poverty reduction. • The importance of social equity is increasing. To reduce the current regional and gender disparities, UPE is important.
Strategic education plan: Promotion of the Curriculum transformation Project	1998	MINED	• The local curriculum promotes the development of necessary skills to solve specific problems in the community.
Action plan for the reduction of absolute	2006	MINED	• Recognition of cultural diversity is an asset

poverty 2006-2009			for Mozambique's identity and national development • Importance of better access to and promotion of knowledge and dissemination of Mozambican culture • Culture is a tool to enhance education and a source of wealth
Education strategic plan 2012 – 2016	2012	MINED	• Aims in education contains reducing poverty, economic, political and cultural development, and nurturing patriotism. • Based on the results of SACMEQ, continue to revise the curriculum to strengthen literacy and numeracy and facilitate greater connection between primary and secondary education.

Table 19. Content related to the sociocultural aspect in the Educational Strategic Plan 2012-2016

Content	Description
Education: A critical factor in reducing poverty and developing the country	Through its National Development Plans, the Government continues to prioritize investments in Education with the aim of empowering citizens to develop their self-esteem and patriotic spirit so that they may actively engage in reducing poverty and promote the country's economic, social, political, and cultural development (p.9)
Economic and social context of the country	The country's economy has been growing steadily at approximately 7-8% per year (GDP). Despite this economic growth, 54% of the population continues to live below the poverty line in 2010 (p.11).
Long-term vision	Education should be directed at cultivating a culture of peace through civic, ethic, moral, and patriotic education, from an early age onward in pre-primary and primary school. Norms regarding good behavior, order, cleanliness and hygiene, decency, self-respect, and respect for others, and for society should be instilled in all citizens. It is necessary to develop educational programs based on family values and respect for African traditions in combination with universally recognized values for a modern society (p.15).
Language of instruction	The language of instruction for basic education is Portuguese. Though the enrolment rate increased between 2000 and 2010, the literacy rate declined. Therefore, basic literacy and numeracy are the main focal points, especially in primary education. Students should acquire Portuguese, a Mozambican local language, and at least one international official language for basic communication (p.58).
International large-scale assessments	In SACMEQ III (2007), it became clear that most sixth-graders did not have basic reading and arithmetic skills. The average was below the regional level and affected the quality of secondary education (p.30).

Source: MINED (2012) Education Strategic Plan 2012–2016, extended until 2019.

Equity

The main topics discussed regarding the component of equity centers on respect for Mozambique's cultural diversity. There are many references relating to respect for the culture of one's own country. The 1992 report titled “Education for All” issued by MINED highlights the need for curriculum reforms in primary education, the promotion of the decentralization of education, and the importance of community participation in education. Since the 1992 report proposed the promotion of the decentralization of education, there has been an ongoing debate on this topic. The Educational Strategic Plan (1999–2003) published in 1998 calls for the elimination of regional disparities in education from the perspective of social justice. Another report on national education strategies published in 1998 mentions the need for a local curriculum that can be set independently by each region to facilitate the development of the capacities needed to solve specific problems in each community. The official document published in 2006 highlights the idea of linking the maintenance of cultural diversity in Mozambique with the reduction of poverty through education:

> The recognition of, and Mozambique's appreciation for cultural diversity are assets that solidify its identity, national unity and development. Thus, we aim for better access to the values and products of Mozambique's culture, the promotion of knowledge, and the popularization of its culture (MINED, 2006, p.88).

Furthermore, the curriculum revision in 2004 called for the inclusion of a 20% local curriculum. The Educational Strategic Plan issued in 2012 uses words related to values that are deeply rooted in Mozambique, such as “respect for others,” “respect for African traditions,” and “family values,” and thus inherits the idea of respecting the culture and values rooted in Mozambique. These descriptions include discussions on the topics of ethnicity, language, and gender. The focus is on the decentralization of education as a means to achieve them. With regards to the local curriculum, a decision was made to include a 20% local curriculum designed by the school and its community in the 2004 curriculum revision. After that, a report issued in 2006 emphasized that cultural diversity is an asset for the identity and national development of Mozambique, and highlighted the importance of maintaining the cultural and ethnic diversity of Mozambique, including its rural areas.

Poverty reduction was identified as a key objective of education in the Education Strategic Plans issued in 1998 and 2012. The elimination of educational disparities between rural areas and cities and the local curriculaystem suiting the needs of each region was

promoted as a means to reduce poverty.

Accordingly, it could be said that a policy has been set out in recent years to maintain the local perspective of respecting diverse ethnicities rooted in each region in Mozambique consistently from the 1990s onward. It has also been considered equally important to follow the trend in globalization and integrate education with it.

Linguistics

A report on the state of education published by MINED in 1990 identified the high dropout and low primary education completion rates as problems (MINED, 1990). Mozambique approached this situation through the medium of instruction. A report on bilingual education published by MINED in 1997 noted that schools that taught in local languages in addition to Portuguese had lower dropout rates and higher school enrolment rates among girls, and that the children had become more capable of expressing and thinking for themselves in class (MINED 1997). Portuguese has been used as the medium of instruction since the colonial era. MINED had conducted pilot surveys on the use of local languages in school education since the mid-1990s. Internationally, UNESCO hosted an intergovernmental conference in 1998 to develop political and technical language policy strategies. Although the need to adopt clear policies on the use and development of native languages was identified (UNESCO 2002a), Mozambique had already begun to promote education in the local language by conducting research long before this. The fact that Mozambique had surveyed the medium of instruction and that they pointed out the importance of teaching in the local language implies that they had an intention to maintain its unique culture in addition to improving the quality of education.

The Education Strategic Plan issued in 2012 stipulated that the medium of instruction for basic education was Portuguese. However, in the 10 years including lower secondary education, students were expected acquire the basics to communicate in Portuguese and in a local Mozambican language, as well as at least one official international language. In addition to protecting its local languages, Mozambique also paid attention to Portuguese, which may become the country's common language, and other global official languages, with a keen eye on rapidly advancing globalization. It also emphasized on the local perspective by promoting measures to use the mother tongue as an educational language in order to improve the literacy rate as low literacy rates hindered the development of the country. The country has been trying to practice multilingual education by promoting the use of one's native language, mother tongue, and an international language as advocated by

UNESCO in 1999.

Ethnomathematics

There is no mention of ethnomathematics in any of the high-level documents. However, the following statement was found in the Action Plan for the Reduction of Absolute Poverty in 2006–2009: “Culture can be seen as a tool for enhancing the quality of education and the source of wealth (MINED, 2006, p.90).” Mozambique has consistently shown that it aims to maintain and develop the diversity of its culture since the 1990s, which reflects that it aims to achieve equity.

Globalization

There are a few references to globalization in some policy documents. The section titled “Long-term Vision of Education” in the Educational Strategic Plan (2012-2016) established in 2012 was the first to make the following statement: “It is necessary to develop education based on the universally recognized values of modern society” (MINED, 2012). It also stated that “respect for the fusion of the values of modern society and African traditions.” This is a future-oriented vision that recognizes multiculturalism while respecting the country's traditions. It is related to the OECD's key competency, “the ability to interact in heterogeneous groups (OECD, 2005a, p.12).” It can be considered a means of thinking from a global perspective. Concerning the quality of education, the results of SACMEQ III are reported with graphs, and point out that in addition to ranking lower than other countries in the region, most Grade 6 students have not mastered basic literacy and calculation skills.

Actually, the SACMEQ III country report mentioned that the average score of mathematics performance of Grade 6 students in Mozambique was 484, which was below the SACMEQ overall average of 510. The average score of all the regions decreased compared to the SACMEQ II. In addition, the percentage of students who performed at the basic levels (Levels 1 and 2) increased. In contrast, the percentage of students who performed at higher levels of mathematics decreased drastically (Magaia et al., 2011). The ministry of education considered this situation seriously and wrote clearly in the policy document.

(2) Analysis of the aims of mathematics education

The aims of mathematics education in the three curricula since independence (1983, 2004, and 2015) are summarized by phases in Table 20. The characteristics of the aims and how they have changed are examined from the perspective of the four sociocultural

components. According to Nakahara (2008), the aims of mathematics education are roughly classified into humanism, pragmatism, and culturalism. These perspectives are relied on in examining the sociocultural aspect.

Table 20. Aims of mathematics education (1983, 2004, and 2015)

Year	Key phrases in the aims of mathematics education
1983	・Response to the concrete problems of daily life. ・Acquisition of habits of thought ・Application of knowledge acquired and awareness that its application serves society. ・Find the correct solution to problematic situations in society.
2004	・Have and apply basic knowledge of mathematics in solving everyday problems. ・Apply mathematical processes through individual or cooperative effort in answering routine questions. ・Think and judge independently, formulate acceptable hypotheses, and reflect critically. ・Understand, interpret, read, speak, and write in mathematical language. ・Appreciate and understand the place of mathematics in the world and its wide application in other disciplines. ・Have interest and perseverance in finding solutions to problematic situations. ・Have interest and positive attitudes toward mathematics.
2015	・Develop problem-solving skills, apply knowledge of counting, calculating, and other skills to situate and guide, identify, relate, classify, estimate, and measure magnitudes, and interpret messages in symbolic and graphic language. ・Instrument to suit the needs of the market. ・Development of mental abilities.

The aims of mathematics education in the 1983 curriculum included phrases such as “solving problems in daily life” and “applying acquired knowledge in solving problems in daily life and social problems.” Characteristics related to pragmatism are explicitly spelled out. The daily life and social problems mentioned here are presumed to be specific to each region in Mozambique, which can best be interpreted from a local perspective. The 2004 and 2015 curricula also include pragmatic objectives. Thus, it can be inferred that they have a consistent and strongly conscious desire for the knowledge and skills to be used in daily life. Some of the content in the 2004 curriculum but not in the 2015 curriculum focuses on humanism such as critical thinking, interest in and positive attitude toward mathematics, and patience. On the other hand, new content added in the 2015 revision include considerations

for work and market needs and the impact on Mozambican society. This content is related to the social demands that emerge after graduating from primary school. They are directly related to the development of Mozambique's economy, which is clearly stated in the Educational Strategic Plan. Content on culturalism, such as cultural inheritance, as described in the Educational Strategic Plan is not mentioned explicitly among in the aims of mathematics education. Throughout history, the objectives of mathematics education in Mozambique since independence has been supported by pragmatic content created from a local perspective. As this is also related to ethnomathematics, it is necessary to analyze it in detail in the middle and small structures. On the other hand, the aims such as 'develop problem-solving skills' and 'understand, interpret, read, speak, and write in mathematical language' can be captured as common aims in which the specificity of ethnomathematics and western mathematics overlap.

The content related to social and economic development in Mozambique, which was newly included in the 2015 revision, is consistent with the content in the Educational Strategic Plan issued in 2012, which argued that economic development is most important. This may be why the content on humanism such as critical thinking ability, interest in mathematics, positive attitudes, and patience included in 2004 was deleted in 2015.

4.2.2 Mathematics Curriculum (middle structure)

(1) Structure of the mathematics curriculum

Table 21 presents the structure of the mathematics curriculum published in 1983, 2004, and 2015. There is a significant difference between the curriculum before and after 1983. The 1983 curriculum describes all the objectives to be achieved in each grade. Most objectives are related to the acquisition of knowledge and skills, but there are also some that describe the application of knowledge acquired such as "solving problems in everyday life." For example, in the case of educational topic related to numbers and calculation domain, the educational content of each grade related to verbs such as "count," "compare," and "calculate" are listed. One of the goals is to "apply these to everyday life." After the objectives, there is an item called "theme," in which the educational content included in the aims as the objectives are broken down.

Table 21. Components of the mathematics curriculum

Year	Content
1983	Aims, Specific objectives, Theme, Orientation of methodology (Grades 1 to 3), Distribution of teaching hours (Grades 3 to 5)
2004	Aims, Theme, Specific objectives, Content, Competencies, Distribution of teaching hours, and Suggested methodology
2015	Aims, Theme, Specific objectives, Content, Competencies, Distribution of teaching hours and Suggested methodology

The 2004 and 2015 curricula are organized within the frameworks of *themes*, *specific objectives*, *contents*, and *competencies*. Themes refer to learning areas such as numbers, calculations, and figures, and educational content in each theme are described under the content section. The major difference from the 1983 curriculum is that competencies were newly added. With regard to this matter, official documents published by the Ministry of Education and INDE in Mozambique in the late 1990s contained phrases that expressed various possibilities for competencies. Setting competencies is a major innovation. It makes it possible to mitigate child poverty and vulnerability and improve the lives of families, communities, and the nation. It also deals with topics relevant to each community and enables the development of abilities in health, food, and raising plants and animals (MINED, 1996b, 1997, 1998). In other words, the competencies established in 2004 aim to pursue equity in education. This can be considered an example of the awareness of the necessary competencies emphasized in each region of Mozambique. Thus, the local viewpoint was emphasized. There is a statement including “dealing with topics related to each community (MINED, 2003, p.XV).” It is necessary to clarify concretely what they are by analyzing individual textbooks.

The 2004 curriculum focused on “basic competencies,” where mathematical skills such as “read and write numbers up to 9” and “perform addition for numbers up to 9” were described as competencies. This applied to other themes with basic mathematics skills like reading, writing, calculating, comparing, and arranging being defined as competencies. What were previously described as the objectives in the 1983 curriculum had become competencies in the 2004 curriculum, whereas the content remained the same. However, in the 2015 curriculum, the competencies section was revised to include “practical competencies.” This revision did not include content on basic knowledge and skills, but practical competencies pertaining to the application of knowledge and skills in everyday life, rather than each piece of knowledge and skill such as “solving problems related to everyday

life for numbers up to 10." The curriculum was revised to define competencies as including the acquisition and application of knowledge and skills to situations in everyday life and solving various problems in one's surroundings. As the way of thinking about competencies had changed between the 2004 and 2015 curricula and because there was a discussion on competencies rooted in the region before 2004, these competencies were revised further in the 2015 revision. The competency set out in the 2015 Mathematics syllabus was similar to one of these key competencies (OECD, 2005a), because all three categories of OECD key competencies were included in varying degrees. Specifically, the use of knowledge and skills in real life naturally requires autonomous activities and collaboration with different groups of people.

The big structure consistently focused on the local perspective, and there was no mention of the global perspective in terms of competencies. There was a significant difference in the "recommended teaching methods" before and after 1983. In the 1983 curriculum, the educational content was explained using text. In the 2004 and 2015 curricula, the educational content was explained in detail with figures and images. For example, the two meanings of subtraction (decrease and difference) were explained with figures, and the methods to be used to teach them are presented in detail. This is useful for teachers in planning their lessons. There is, however, no mention of the sociocultural aspect.

(2) Educational content and their presentation

Table 22 summarizes the 2004 and 2015 curriculum revisions. In the educational content for integers, which is the most fundamental part of learning mathematics, the number of digits was increased by one for each grade until Grade 7, but in the 2015 revision, by taking advantage of the Portuguese number system, each grade increased by 3 digits each time from Grade 3 onward, and thus the content on integers was completed in Grade 5. The 1983 and 2004 curricula introduced the division of integers in Grade 3, but the 2015 curriculum introduced division in Grade 2. In the 1983 curriculum, only "simple fractions" were included for Grade 5, and there were no detailed descriptions. However, in the 2004 curriculum, fractions were described in detail with insights on the types of fractions and notations. Decimal numbers have continued to be introduced at the same level since 1983. In the 1983 and 2004 curricula, all four arithmetic operations of fractions were introduced in Grade 5. In the 2015 curriculum, addition and subtraction alone were introduced in Grade 5, and multiplication and division in Grade 6. Most educational content had been revised, especially in the 2015 curriculum. Most revisions involved the reduction of educational

content. The curriculum was revised in such a way that the burden on the lower grades was reduced and more children were able to learn the basics. In addition, the number of digits of integers learned in each grade has been changed to increase by 3 digits in each grade, and the learning of division and decimals has been revised in consideration of systematics, such as making arrangement that is conscious of the spiral nature of the educational content. “Sets” were removed from primary education after the modernization of mathematics education in the 2015 revision. As stated in the Educational Strategic Plan issued in 2012, these revisions were presumed to be influenced by the policy of strengthening numeracy as the results of SACMEQ were not good. As the curriculum that was directly taken from Portugal was intended either for educating the elite or for screening students, the 1983 curriculum was packed with content for the primary education level. However, each revision made changes in the content and the quantity to be taught in each grade. Although there is no mention of the sociocultural aspect in the curriculum, it is presumed that by reducing or delaying the acquisition of educational content, efforts are being made to reduce the dropout rates in the lower grades to achieve MFA. Section 3 of this chapter clarifies the background for these revisions by analyzing and discuss the 2015 curriculum revision process in relation to the sociocultural aspect.

Table 22. Changes in learning content between the 2004 and 2015 curricula

Domain	Content	Revision in 2004	Revision in 2015
Number and calculation	Natural number	・Numbers up to 100 in Grade 1 instead of up to 20.	・Expanding 3-digit in every grade instead of 1-digit in every grade.
	Addition/Subtraction	・Addition and subtraction up to 50 instead of up to 20	
	Multiplication/ Division	・Concerning division in Grade 3, limitation of dividend is 1000 instead of 10000	・The meaning of division was to be taught in Grade 2 to instead of Grade 3.
			・Changing Multiplication and division from up to 100 in Grade 1 to up to 50.
	Fraction	・Introducing fractions in Grade 4	

	Decimal numbers		Addition and subtraction are taught in Grade 5, multiplication and division are taught in Grade 6.
	Roman numerals	・Roman numerals up to 12 in Grade 2 and up to 20 in Grade 3 newly included.	They are shifted from Grade 2 to Grade 3, and from Grade 3 to Grade 4 respectively.
	Algebra	・Mathematical expression with letters is introduced in Grade 4	
	Number line		Introduction of the number line is shifted from Grade 1 to Grade 5.
Geometry	Basic shapes	・Shifting square and triangle from Grades 1 to 2. ・Drawing square, rectangle, and triangle from Grades 2 to 3.	・Shifting drawing triangles to Grade 4 ・Shifting the types of triangle from Grades 4 to 5
	Parallelogram	・Shifting definition and drawing from Grade 2 to 3.	Shifting definition and drawing to Grade 5
	Circle	・Shifting drawing circle from Grade 2 to 3.	Shifting drawing circle to Grade 7
Measurement	Time	・Introducing the art of telling time and reading a calendar in Grade 2	
	Table and graph	・Shifting simple table and graph from Grade 4 to 3 ・Shifting bar graph from Grade 5 to 4	Shifting simple table and graph from Grade 3 to 4
	Set		Shifting from Grade 6 to secondary education.
	Coordinate plane		Shifting from Grade 6 to secondary education.

The middle structure is analysed from the perspective of four components.

Equity

The learning content of lower grades has been reduced in each revision and delayed to the upper grades. This not only takes into account the timeliness of the learner but also indicates a change in attitudes towards education. Education has been seen as a way of selecting good students. This is why difficult learning content was included in the early grades. The reduction of learning content in the lower grades means that the aim of education has changed from selecting good students to ensuring that all children acquire a minimum level of basic academic skills.

The competencies established in 2004 are aimed at pursuing equity in education. The necessary competencies in each region or community of Mozambique were considered in the mathematics curriculum. Thus, the equity from local perspectives was emphasised.

Linguistics

There is nothing written in the syllabus that relates to linguistics. However, there is a domain of study in Year 1 called 'vocabulary', where learning terms related to mathematics are explained. It is considered that this domain is to facilitate learning in Portuguese for children who have grown up in the local language.

Ethnomathematics

There is nothing in the syllabus that relates to ethnomathematics. However, as mentioned in the equity, competencies were set in the 2004 curriculum revision, which attempted to incorporate local and community needs. Although there is no mention of this in the national syllabus, it is considered that learning content related to ethnomathematics is expected to be put into practice using the ‘local curriculum’ described in the big structure.

Globalization

Discussions on competencies began in the late 1990s, and the establishment of competencies in the 2004 revision is in line with global trends. In addition, it is also in line with global trends with regard to the attempt to move away from the curriculum influenced by the new maths movement by reducing difficult learning content from the primary school curriculum. However, it is necessary to examine the curriculum revision process to understand the context in which such revisions were made.

4.2.3 Textbook (small structure)

A comparative analysis of two textbooks corresponding to the 2004 and 2015 curricula was conducted on the following two perspectives explained in the methodology: (1) Problem situations related to the real-world, (2) Photographs, pictures and figures used in textbooks. These factors are discussed from the perspective of the four sociocultural components that are of interest in this study.

(1) Problem situations related to the real-world

First, the extent to which real-world problems feature in each textbook is clarified. In the structure of textbooks, questions related to the real-world are aimed at constructing meaning while introducing new educational content, or may be positioned to focus on mastering computational algorithms and definitions and developing the ability to utilize these skills. Therefore, the two textbooks are analyzed on the percentage of problems related to real-world, distinguishing between problems that introduce a new educational content and other exercises.

For questions introducing new educational content, Table 23 shows the number of chapters and sections, as well as the percentage of problem situations related to the real-world in the section's introduction. The 2004 textbook is carefully broken down into small sections. The number of sections is more than thrice that in the 2015 textbook. The percentage of problem situations related to the real-world was 52.9% in the 2004 textbook, and 56.6% in the 2015 textbook. Although it is 3.7% higher in 2015, the result was not statistically significant ($p = 0.71 > 0.05$).

Table 23. Ratio of real-world problems in section's introduction

	2004	2015
Number of chapters	7	4
Number of sections	47	12
Percentage of real-world problems (%)	52.9%	56.6%

Second, the number and percentage of problem situations related to the real-world in the exercises are compared (Table 24). The 2015 curriculum had 36 more exercises. With regard to the number of problems that relate to real-world scenarios, the 2004 textbook had 103 questions (31.4%), whereas the 2015 textbook had 139 (40.6%). The 2015 textbook had about 9.2% more questions than 2004 textbook. The difference was statistically significant

at the 95% confidence level ($p = 0.013 < 0.05$), showing that the number of problems related to realistic situations increased in 2015.

Table 24. Ratio of real-world problems in exercises

	2004	2015
Number of exercises	328	344
Number of exercises related to real-world problems (%)	103(31.4%)	139(40.6%)

Third, with reference to Nagasaki (2000), the real-world problems were categorized. Tables 25 and 26 present data for the 2004 and 2015 textbooks, respectively. The 2004 textbook had 12 situations and 43 items, whereas the 2015 textbook had 15 situations and 64 items. The 2015 textbook had 3 more situations and 21 more items than the 2004 textbook, and covered a wider range of situations. Content related to family life and social life accounted for 27.9% in both categories for the 2004 textbook, and 23.3% and 24.0% for the 2015 one, respectively. In both textbooks, situations related to family life and life in society were common. Both textbooks had problems pertaining to markets. These problems have situations related to the seller's side, concerning the wholesale of items such as cloth, rice, and agricultural products. Children may experience these situations in the future, but they are not practical questions for children at this point in time.

Mozambique has low enrolment rates in secondary education, at 42.5% (JICA, 2015). Many such concerns may refer to children from Grade 3 onward as it is considered necessary for children to learn to work, for which primary education alone is seen as sufficient. By using these questions as subjects in school mathematics, the children get the opportunity to think about the social systems in the real-world that they will face in the future in mathematical terms. The 2015 textbook included new situations such as those pertaining to health centers, adult literacy education, government support, and fetching water. For example, the daily number of adult and child patients who visit the health center in the Maxaquene district of Maputo are introduced as a word problem with a specific photo of the center. In addition, concerning adult literacy, the number of people who join the adult literacy program in Tete province are introduced as a part of the situation problem.

Children do not have the opportunity to consciously interact with the former two. Thus, the 2015 curriculum gave them an opportunity to learn about these situations through mathematics education. All these problem situations use specific place names and actual situations, which gives children an opportunity to learn about life in each city in

Mozambique vis-à-vis mathematics. The 2015 textbook included three problems on the Mozambican flag and Independence Day. This may be that this is a subject linked to the word “patriotism” stated in the Educational Strategic Plan (2012 - 2016) issued in 2012.

Both textbooks mention situations concerning Mozambican geography, social science, and cloth. In the 2015 textbook, situations pertaining to the culture of Mozambique, such as traditional crafts and buildings, increased significantly. Facilitating cultural inheritance is a fundamental role of education (Baba, 2014), and the fact that such situations are often dealt with emphasizes understanding and inheritance of the culture of one's own country. On the other hand, the 2015 textbook contains only one question on relations with other African and foreign countries, as well as foreign societies and cultures. The big structure analysis revealed that the emphasis is placed on the local viewpoint, which is confirmed through the small structure analysis.

Table 25. Categorization of real-world problems in the 2004 textbook

Context (No. of problem, %)		No. of problems
Family life 31 (27.9%)	House	1
	Things in the house	5
	Shopping	6
	Food	8
	Book	2
	Gift	1
	Toys	4
	Daily time schedule	2
	Leisure	2
School life 7 (6.3%)	School supplies	4
	Body	1
	Exercise	1
	Number of students	1
Social life 31 (27.9%)	Building	2
	Traditional building	3
	Wall of a building	1
	Factory	1
	Transport	5
	Library	1
	Postal service	2
	Gold and silver	2
	Money	2
	Market	12

Context (No of problem, %)		No. of problems
Transportation 8 (7.1%)	Petrol	1
	Vehicles	4
	Bus	2
	Ship	1
Agriculture 3 (2.7%)	Agricultural products, livestock	3
Fishery 2 (1.8%)	Catch of fish	1
	Fishing boat	1
Social science 4 (3.6%)	Map	2
	States	1
	Human body	1
Natural science 7 (6.3%)	Scale	4
	Plants	1
	Animals	2
Sports 6 (5.4%)	Football	1
	Swimming	3
	Basketball	2
Play 1 (0.9%)	Kite	1
Industry 9 (8.1%)	Metal wire	1
	Mozambican cloth	8
Environment 2 (1.8%)	Forest	2

Table 26. Categorization of real-world problems in the 2015 textbook

Context (No. of problem, %)		No. of problems
Family life 31 (23.3%)	House	1
	Things in the house	2
	Shopping	10
	Food	10
	Cooking	4
	Present	3
	Cloth	1
	Fetching water	2
	Daily time schedule	2
	Birthday	2
School life 18 (13.5%)	Number of students	2
	Study	1
	School supply	9
	Event	2
	Body	1
	Daily time schedule	3
Social life 32 (24.0%)	Health care center	6
	Company	1
	Market	9
	Ring	1
	Money	2
	Hourly wage	1
	Factory	5
	Small shop	1
	Calendar	1
	Age	1
	Government support	1
	Adult literacy education	1
	Chorus group	1
	Water distribution	1
Transportation 7 (5.3%)	Road sign	1
	Bicycle	2
	Train	2
	Bus	1
	Petrol	1

Context (No of problem, %)		No. of problems
Agriculture 15 (11.3%)	Crops	8
	Livestock	5
	Farmland	1
	Agricultural training	1
Fishery 2 (1.5%)	Catch of fish	1
	Fishing boat	1
Social science 1 (0.8%)	Map	1
Natural science 4 (3.0%)	Scale	2
	Air bubble level	1
	Animals	1
Sports 4 (3.0%)	Athletics	1
	Basketball	1
	Football	1
	Sports festival	1
Art 2 (1.5%)	Music	1
	Traditional crafts	1
Play 4 (3.0%)	Kite	1
	Flower necklace	1
	Marbles	2
Industry 4 (3.0%)	Mozambican cloth	2
	Architecture	1
	Cotton production	1
Culture 7 (5.3%)	Independence day	1
	National flags	2
	Traditional crafts	2
	Traditional building	1
	Festivals	1
International understanding 1 (0.8%)	European history	1
Environment 1 (0.8%)	Tree planting	1

(2) Photographs, pictures, and drawings used in Textbooks

A comparative analysis of the photographs, pictures, and drawings used in the textbooks was conducted using the method presented in 3.1.2. The contents of the photographs, pictures and drawings used in the textbooks differ greatly between the 2004 and 2015 textbooks. The 1) use of photographs, pictures and drawing unique to Mozambique, 2) consideration for gender and inclusiveness, and 3) Mozambique's identity are particularly characteristic. Therefore, these three are analyzed relating to the actual problems presented in the textbook, and discussed in relation to the sociocultural components. Finally, these three points of view are considered from the perspective of four sociocultural components, namely, equity, linguistics, ethnomathematics, and globalization.

1) Use of photographs, pictures, and drawings unique to Mozambique

Both textbooks used photographs, pictures, and drawings related to the situations presented in the questions. The 2004 textbook did not use any photos, whereas the 2015 textbook used 16 photos. There were hardly any pictures or drawings pertaining to Mozambique in the 2004 textbook, whereas all photographs, pictures, and drawings in the 2015 textbook were specific to Mozambique. The 2015 textbook depicted many situations related to agriculture, fisheries, and industry, where specific places were shown with photos and pictures.

This difference is because the 2004 textbook was developed by a private company, whereas the 2015 one was Mozambique's first national textbook, developed and produced by INDE. The World Bank (2015) stated that merely distributing many textbooks to students does not improve their academic ability; it is necessary to supply appropriate textbooks that can actually work to improve their academic ability. Thus, many English and French textbooks were imported from British and French companies in the early 2000s; however, these textbooks were inappropriate as they did not consider the African culture and language (Alidou, 2004). In addition, UNESCO (2014) included the context of the local culture and community as one of the conditions for an appropriate textbook and mentioned that the content must also consider gender, cultural diversity, environmental conservation, etc. The revision of Mozambique's textbooks was conducted in line with these observations. Textbooks created to implement the 2015 curriculum revision contain many photographs and pictures of the culture and communities of each region in Mozambique. On the other hand, while it was mentioned that there are hardly any problem situations related to neighboring countries and foreign countries, no pictures, photographs or drawings related to

them either appear in the textbooks.

2) Awareness of gender, race, ethnicity, and inclusiveness

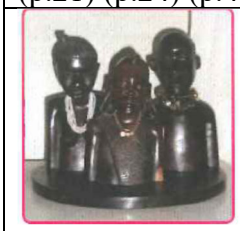
Pictures that portrayed problem situations based on school life depicted boys and girls in different skin and hair colors. Furthermore, children in wheelchairs were also depicted. These factors indicated that textbooks were conscious of identity aspects such as ability, gender, race, ethnicity, and inclusiveness. These are consistent with the content described in the policy documents in the big structure. It can be said that the educational policies are embodied in the textbooks.

3) Identity as Mozambican

Mozambican flags are used and shown in problems related to track and field, where athletes are pictured holding the national flag, and in materials to learn even and odd numbers. A picture of the Mozambican flag is included in problem situations related to raising a national flag during the morning assembly. Although there aren't a lot, pictures such as those of the national flag are always included in such problem situations. This may have been done to relate to the Mozambican identity.

As mentioned in the classification of problem situations, in the 2015 mathematics textbook, many photographs, pictures, and drawings related to the industries and cultures of various regions of Mozambique are used so that the society can be widely known through learning mathematics. Photos and drawings have also been used to raise awareness of identity and inclusiveness as Mozambicans. The big structure analysis showed that emphasis is placed on the local perspective of respecting the diverse ethnicities in each region of Mozambique, and this is embodied in the textbooks.

Table 27. Photos and drawings used in Grade 3 math textbooks (2015)

  (p.81) (p. 129)	Fishing port in Inhambane, Size of catch (Measurement)
 (p.83)	Train station in Maputo, Movement of people to the region (Time and duration)
   (p.92) (p.96) (p.19)	Vaccinations at schools and health centers Maxaquene health centers, (Various situation problems in number and calculation)
   (p.24) (p.127) (p.23)	Boys and girls depicted with various skin and hair colors, using wheelchairs, and playing together (All the domains, all the situation problems)
  (p.91) (p.31)	Water distribution (Capacity)
   (p.21) (p.24) (p.45)	**National flag** (Geometry, addition, and subtraction)
  (p.128) (p.104)	Wood carving and traditional buildings in Maputo

Finally, the small structure is analysed from the perspective of four components.

Equity

As mentioned above, pictures of boys and girls with different skin and hair colors are used in the textbook. In addition, children in wheelchairs were also used in various pages. This indicates that gender, race, ethnicity, and inclusiveness are considered very well as equity in mathematics education. These principles are consistent with the content described in the policy documents in the big structure.

Linguistics

Content related to linguistics was not included in the textbook. As the textbooks have been translated into 16 languages, it would be possible to identify mathematical features from a linguistic point of view by analysing textbooks in other languages.

Ethnomathematics

The categorisation of real-world problems in the 2015 textbook had the most content on social life. For example, rural life and fetching water were taken up as topics. There was an awareness of learning about Mozambican society through mathematics education.
There is no study material on ethnomathematics itself. Therefore, in terms of the content of mathematics education, it is based on western mathematics. On the other hand, the contexts of the word problems are all specific to Mozambique. These word problems linked to the real world, such as scenes of life and work in different regions of the country, are used together with pictures. This is a strong indication of the objective of learning about Mozambican society through mathematics.

Globalization

The concept of inclusiveness, including showing children of different races and disabilities in textbooks, is a current global trend. It is necessary to analyse the debate on the curriculum revision process to see whether this idea is simply following a global trend or whether it is something that concerns real-world problems. Mozambique places a special emphasis on learning about communities within Mozambique through mathematics. There were few problem situations of other African countries or the rest of the world.

4.2.4 Analysis of the curriculum development process

(1) Stages in the curriculum revision process

The revision of the mathematics curriculum in 2015 took place over three stages. The objectives of and members who attended the meeting at each stage are listed in chronological order:

1) The INDE curriculum revision working group created a revision plan (2013, about 6 months). INDE is subordinate to the MEHD in Mozambique and is responsible for curriculum development and general (primary and secondary) education planning as well as teacher training. Six mathematics officials led by INDE Director Dr Ismael prepared the first draft of the revised curriculum. The team members have no experience of studying abroad. The team leader has a PhD and the others have a bachelor's or certificate for teacher training college.
2) Meeting with external experts (2014, 10 months): The draft of the revised curriculum was discussed with experts from outside the organization. A total of 30 participants (including representatives from the MEHD, randomly selected teachers with at least 10 years' experience, university officials, the Bank of Mozambique, and Mozambican social and economic groups) engaged as experts. The embassy of Finland shared their experience in curriculum revision. The INDE group brought back matters presented during this meeting, and discussed them internally to create an amended draft. They repeated this cycle thrice.
3) Approval (2015): The final approval process was carried out in two sub stages by technical and advisory committees. The technical committee was chaired by the Vice-Minister and comprised 25 people, including the Head of the Education Bureau of each province, members of civil society, and university professors. The advisory committee, representing the final stage of the approval process was chaired by the Minister of Education. It included the Vice-Minister and members of the advisory council of the MEHD and formally approved the revised curriculum.

(2) Materials referred to and discussion topics developed at each stage of the revision process

The materials cited and discussions that took place during the curriculum revision process were summarized based on interviews with two officers who were members of 2015 curriculum revision committee. The author interviewed the one first, and then the other to confirm the findings drawn from the interview with the first officer.

1) The INDE curriculum revision team created a draft of the revised curriculum

The INDE curriculum revision team conducted discussions and created a draft of the revised curriculum over a period of 6 months in 2013. The first draft aimed at ensuring that all children would acquire basic numeracy. Studies like SACMEQ, national assessment, and monitoring reports by INDE showed that students did not acquire essential skills in primary education. The materials used and the content discussed during the curriculum revision process were arranged in stages, based on interviews with the two interviewees from INDE. In addition to conducting the graduation examination each year, INDE regularly monitors school classrooms and interviews teachers and parents. These results were used in the 2015 curriculum revision process. The materials used to prepare the curriculum revision plan and related issues are summarized in Table 28.

Table 28. Materials used by INDE to draft the revised curriculum

Materials used	Matters for consideration
SACMEQ III country report Magaia et al. (2011)	- There was a significant decrease in Mozambique's national mean score of mathematics in SACMEQ III (Magaia et al., 2011). - The team compared the report on Mozambique with those of other countries and changed the language policy (in response to neighboring countries, which changed to mother-tongue-based education in 2003). - Increased the number of mathematics lessons from 296 to 380 (Grades 1 and 2). - INDE did not refer to detailed mathematics content.
Year 3 student assessment reports (held every three years) (INDE, 2017)	- Students were incapable of basic reading, writing, and calculations; the results were far worse than expected. 10000 students from 400 schools were selected. Level 1: Counting numbers and identifying geometric figures. (89.4%). Level 2: Writing numbers and doing basic calculations (50.3%). Level 3: Solving problems (7.7%). - Many teachers said that they had no problem with the content to be taught, but that there were too many subjects and they could not teach them all. Thus, the curricula for Years 1 and 2 were changed, and went from having six to three subjects

Graduation examination for students of Years 7, 10, and 12 (INDE, 2017)	Mathematics was one of the subjects with a minimum pass rate. For example, the pass rate for Year 12 students was 12% (2011), 10% (2012), and 12% (2012). The situation has not changed. The fact that basic academic abilities were not being acquired was considered a problem.
Questionnaire for teachers and school principals (held every three years) (INDE, 2017)	- 60.7 % of Grade 3 teachers thought that given teaching materials are insufficient. - 25.7 % of Grade 3 teachers thought that teaching time was not sufficient to cover all the content. - 63.4 % of Grade 3 teachers were able to teach all the learning content.
Interviews with parents	Many were dissatisfied because their children were going to school but could not read, write, or do calculations
Interviews with economic and social groups	These groups were dissatisfied because students did not acquire basic academic abilities. They asked for greater emphasis on financial literacy
Curricula of other countries	The 2004 syllabus referred to Brazil and various European countries, especially learning content and competencies are arranged structurally. The 2015 revision hardly referred to other countries, but the embassy of Finland participated in the meeting and share their experience in curriculum revision

Source: Developed by author

2) Meeting with external experts

Around 10 meetings during 10 months were held to discuss the primary curriculum. The external experts discussed ways to include and reflect social issues such as family planning, nutrition, traffic accidents, and money management in the curriculum. Discussions on arithmetic content revolved around financial literacy, such as the calculation of tax, interest rate, and so on, reinforcing mental calculation, and the need to memorize the multiplication table. As the Banks of Mozambique and other private groups demanded the inclusion of financial literacy, the group decided to include it in the curriculum. INDE considered the issue of multiplication table memorization and ultimately concluded that it was more important for students to understand the meaning properly. At present, memorization is not included in the curriculum.

3) Approval

Approval was provided in two sub stages by a technical and an advisory committee. In the technical committee, the discussion mainly concerned steps toward implementing the

revised curriculum. However, the content was not discussed concretely. In the advisory committee, which handled the final stage in the approval process, the content was not discussed. The committee was chaired by the Minister of Education, and the revised curriculum was formally approved by the Vice-Minister and MEHD.

(3) Interviews on the background of the curriculum revision process

Through the interview with the two members of the working group, the author clarified issues which cannot be found out only from the document analysis such as leadership, the background of the revision, who decided which content to revise, and the views of the INDE (which plays a central role in curriculum revision in general) on mathematics education in Mozambique.

Question 1: Who ultimately decides the distribution of the content for learning?

Answer: The reports of the investigation results were used as decision-making materials for the revision. Decisions on the content of mathematics, such as how it should be distributed between levels were made through discussions within the INDE curriculum revision team.

Question 2: Ten years have passed since the previous revision. Is this a fixed period?

Answer: The period is not set, but about 10 years is necessary to introduce and evaluate a new curriculum, and create links to the revised version.

Question 3: While creating the draft revision, did you refer to other countries' curricula or bring in consultants from other countries to work on it?

Answer: In the 2004 revision, we referred to Brazil and various European countries and held discussions involving experts from Brazil, but we have not done so this time. We looked back at the past 10 years. This time, we are creating the curriculum from precedents.

Question 4: What were the changes in the aims of mathematics education between 2004 and 2015?

Answer: The descriptions have changed. However, the direction and purpose of mathematics education have not. Some texts are not written in the form of aims, but the aims are covered in the preamble and throughout the curriculum.

Question 5: Where is the debate held on the kind of education the country will provide and the direction and aims of mathematics education?

Answer: The debate is hosted by the MEHD, after which, an Educational Strategic Plan is created. INDE revises the curriculum based on this policy. We prioritize the

elimination of poverty and the use of education (numeracy and literacy) as a means of doing so. Numeracy and literacy are mentioned in the SACMEQ results. We share the thought that education is important for economic development, and think about mathematics education based on this.

Question 6: How do you see the problems in Mozambique's mathematics education?

Answer: We consider the drop in secondary education levels, compared to several years ago, a serious problem. While access to secondary education is expanding each year, quality is significantly falling. Maintaining quality as the youth population continues to grow is a serious problem. Therefore, we must foster qualified teachers with expertise in mathematics.

(4) Analysis

The author discusses the results with respect to the materials used and the discussions conducted during the curriculum revision and the discussion in the curriculum revision process.

1) Materials used for curriculum revision

The results of SACMEQ were used as the main material that was surveyed by external organizations in the 2015 curriculum revision process. They referred to the number of lesson hours and the language of instruction. However, they also referred to the results of the surveys conducted independently by INDE and MEHD along with other external materials. The goals of mathematics education have changed. Most of the learning content has been delayed to upper grades. It was clear from the interview that the detailed learning content of mathematics did not directly refer to external material. In other words, these changes seem to be largely due to the results of graduation examination and interviews with parents, economics and social groups as part of the curriculum revision process. Therefore, the experience and knowledge of Mozambique's own journey with mathematics education were noted, and revisions were made based on them. In addition, in response to the interview questions regarding the reference to curricula from other countries or consultants from other countries, officials responded that they referred to Brazil and various Western countries' curriculum in the 2004 curriculum revision but not in 2015 revision. The war for independence and the civil war that continued until 1992 and full-scale educational development started to be taken place at the end of the 20th century. However, in the 2004 curriculum revision, consultants from various countries were actually involved in the

revision. This openness to curriculum development from other countries and regions may have something to do with the peculiarity of Mozambique's history.

It is not clear how much initiative Mozambique had in discussions with consultants from other countries in the 2004 revision. It can be said that they directly borrowed the curriculum, knowledge, and experience of other countries in the 2004 revision, but in 2015, Mozambique revised it based on the accumulated experience to some extent. Furthermore, as a reason for not relying on the other country, they said that they had carefully reviewed the past 10 years' data and did not create a curriculum from scratch. The term "reviewed past ten years' data" means the data, reports, and other materials that had accumulated over the last 10 years and used in this curriculum revision. In particular, Mozambique has independently accumulated the data of regular assessments for Grade 3 and the annual graduation exams for Grades 7, 10, and 12. The curriculum has been revised based on these assessments. More specifically, it was clarified that through the interview that they referred to the curriculum of other countries to organize the learning content and competencies structurally in 2004 curriculum revision, but they rearranged them based on their accumulated data in 2015 curriculum revision. Therefore, it can be said that internalization of the borrowed curriculum has been promoted. The experience of their own country has been accumulated in 10 years period of time, and they revised it also by taking into consideration considering the current situation of education. It seems that the borrowed content has been adapted to the society of Mozambique relatively smoothly, which means they are in the process of "2. Absorption of educational elements of other countries" and "3. Synthesis" in internalization (Phillips & Ochs, 2003, p.452). Baba (2014) pointed out the importance of a group of experts who understand the country's educational issues and the accumulation of data by their own country. INDE has been steadily developing the country's own experts in mathematics education.

The survey conducted by INDE on a regular basis includes educators and various stakeholders in Mozambican society such as parents, and private and economic organizations (INDE, 2017). It is important for INDE to continue to work closely with Mozambican society to conduct fundamental discussions on mathematics education and accumulate experience for use in curriculum revisions. As a result, it becomes possible to borrow curriculum of other countries and global educational trends with the purpose of linking them with the situation of their own country, and internalize them.

2) Discussion of the curriculum revision process

From the interview, the author found out that, various social and economic groups asked the committee to include financial literacy, mental calculation, memorization of multiplication tables, and other topics within the curriculum. The state has prioritized economic expansion as a national development goal and has proposed education targets to achieve this goal. Social and economic groups offered opinions in alignment with these political regulations. Although INDE argued that understanding was better than memorization, it responded to social expectations (regulations) by adding financial literacy. With regard to the importance of including financial literacy in mathematics education, this has been discussed in international organizations like the OECD, and the framework for international large-scale assessments such as PISA also includes financial literacy (OECD, 2005b, 2013b). Therefore, at first glance, it can be considered the effect of globalization, but it is a revision to address the opinions of local community. On the other hand, the main revision was to reduce the amount of learning content in lower grades. This is a shift in the aims of education from the selection of the elite to the emphasis on the development of basic academic skills for all children. This is related to "equity," in ensuring that all children acquire basic academic abilities.

As a revision related to the scope and sequence of learning content, the number of digits of integers increases by 1-digit every grade to by 3-digit. This was done by taking advantage of the characteristics of the number system in Portuguese (Table 23). However, no other major changes were made. There was no discussion on "ethnomathematics." related to the equity of educational content. Although the aims of mathematics education had changed drastically, two officers who took interview could not explain the reason why they were changed. Detailed discussions on how mathematics education should be presented were not held. In other words, which abilities and skills should be acquired through which learning content and what are their connection to the objectives of mathematics education were not discussed. To promote these discussions, it is necessary for INDE officials, who are already experts on each subject, to become even more specialized and conduct deeper discussions by drawing on specialist knowledge to improve mathematics education. As globalization is ongoing, it is important not to ignore global trends and other countries' curricula. It is important to discuss and make decisions with due consideration for all these aspects. Thus, a "theoretical decision" should be made instead of a "false" or "hurried" one in the second stage of education borrowing. Then, the process can move smoothly toward "internalization" and "implementation" in the third and fourth stages, respectively. The author found that

INDE has made a detailed proposal and the final decision, incorporating the opinions of the external experts.

4.2.5 Comprehensive analysis

Characteristics of the sociocultural aspect of Mozambique's intended mathematics curriculum are summarized in Table 29. In terms of equity, the learning content has been reduced in every curriculum revision. Therefore, it can be considered that the aim of education has shifted from addressing the elites to including all children. It became clear that these revisions were made based on locally gathered data through the interview. In terms of linguistics, research of learning mathematics in the mother tongue have been conducted since 1990s. In recent years, the results of those research have been reflected in policy such as the production of textbooks in local languages. The bilingual education program using the local language is now implemented in 1907 schools, covering every province in Mozambique (MINEDH, 2020).

Concerning ethnomathematics, the importance of cultural diversity has been constantly discussed since 1990s at policy level. Real objects and phots of diverse religion appeared in the most recent textbook according to the 2015 curriculum revision. It can be said that the ethnomathematics is being utilized for understanding of the national and local culture of Mozambique. Finally, concerning the globalization, global trends has not been discussed much, and even they are not mentioned much in policy documents. Textbooks do not contain much reference of other countries or the world. Furthermore, the introduction of financial literacy, as first glance it can be considered the influence of globalization, however, the analysis of the curriculum revision process showed that it was due to requests from domestic social groups.

Table 29. Characteristics of Mozambican mathematics curriculum development

	Curriculum (Product)		Development process (Process)
	Big, Middle	Small	
Equity	The learning content is reduced in lower grade. **The aims of education has shifted from addressing the elites to including all children.**	Offering children opportunities to understand situations they may face in the future.	Revisions are made based on locally gathered data. **Changes were made based on evidence.**
Linguistics	Promoting mathematics education in local languages. **Learning mathematics in the mother tongue, which has been discussed since the 1990s has been achieved only in recent times.**	Numbers 6 to 10 are expressed using one's fingers with due respect for local languages.	
Ethnomathematics	Commitment to the development of cultural diversity in education since the 1990s. **・Ethnomathematics is utilized for understanding national culture.** **・Contents outlined in the policy document are embodied in the textbooks.**	・Real objects and photographs are used to teach geometry and measurement. ・A diverse range of children are presented.	
Globalization	・SACMEQ III results are considered ・Very few mentions of global trends. **At first glance, it can be considered the influence of globalization. However, in reality, these impacts emerged from local demands.**	・National flags are incorporated in problem situations, ・Very few international situations are included.	・Very limited discussion of global trends in mathematics education. ・Social and economic organizations demanded the inclusion of financial literacy in the curriculum.

4.3 Summary of Chapter 4

This chapter analyzed the mathematics curriculum development process in Mozambique. Section 2 examined the three primary mathematics curricula presented after Mozambique's independence. It became clear that since it gained independence, Mozambique has consistently sought to respect its people and culture, while both maintaining and passing it on to future generations.

Section 3 examined the 2015 curriculum revision based on the educational borrowing theory described in Chapter 2. Although the results of SACMEQ became the starting point, it became clear that assessments for grade 3 and surveys on teachers and communities were conducted and the resulting data was used for the revision. There are debates world over around the inclusion of financial literacy components in the mathematics curriculum. In Mozambique, financial literacy was added to the curriculum not to follow of the global debate but to respond to the requests of domestic social and economic organizations. Furthermore, it became clear that INDE has led the revision throughout the curriculum revision process. This means that Mozambique has been trying to revise the curriculum based on its own knowledge and experience.

The results of the analyses here lead to discussions on the characteristics of the sociocultural aspect of Mozambique's mathematics curriculum development in Chapter 5.

CHAPTER 5
DISCUSSION AND CONCLUSION

This chapter discusses and clarifies the characteristics of the sociocultural aspect of mathematics curriculum development in Mozambique with reference to the global discourse on the four sociocultural components discussed in Chapter 2. Section 1 clarifies the characteristics of the sociocultural components of mathematics curriculum development in Mozambique with reference to the global discourse. Section 2 examines the uniqueness of Mozambique's mathematics curriculum by focusing on portions that differ from the global context. Where there are no differences, portions that were developed in keeping with the Mozambican context are analyzed.

5.1 Characteristics of Mozambique's mathematics curriculum development

This section clarifies the characteristics of the sociocultural aspect of mathematics curriculum development in Mozambique with reference to the global discourse on the four sociocultural components.

5.1.1 Equity: Equity for educational aims

Equity in policy documents and objectives of mathematics education, which forms the big structure of the analytical framework, is discussed. A report "Basic education in Mozambique: Present situation and prospects (MINED, 1996b)" pointed out the low school enrolment and high dropout rates, and low rates of completion of primary education. A report "Education for All: Mozambique: A Strategy (MINED, 1992)" proposed the promotion of the decentralization of education. The decentralization of education has been continuously discussed, and the Educational Strategic Plan published in 1998 described the importance of the elimination of regional disparity in education in light of social impartiality. Other reports issued that year also mentioned the need for local curricula to promote the development of abilities required to solve particular problems in each community. Local curricula constituted 20% of the main curriculum designed by schools and the community, in order to adapt to the needs of each regions, during the 2004 revision.

Mitigation of poverty was one of the objectives of education in the Educational Strategic Plan published in 1998. The Report on the Strategy for the Mitigation of Poverty issued in 2006 described that cultural diversity was an asset for identity and development of

Mozambique to present the importance of sustention of cultural and ethnic diversity including that in the local area. It is presumed that elimination of educational disparity between the countryside and cities, and the adoption of local curricula to suit the needs of individual regions were the most important points in the discussion on the achievement of equity and mitigation of poverty. These can be regarded as equity with its focus on local, which closely relate to "linguistics" that is categorized into equity as educational means, and "ethnomathematics" that is categorized into equity of educational content. The Educational Strategic Plan published in 2012 presented the mitigation of poverty and respect for culture and heritage of Mozambique as the objective of education. In both Mozambique and other countries, culture, race, and gender have been continuously discussed as equity since 1990. This was actualized in mathematics textbooks.

In contrast, whereas content concerning socio economic status and inclusiveness are currently being discussed, political statements from Mozambique have mentioned only the need to implement education based on modern social values. It does not offer any more description.

A common factor in all three curricula after the independence is that the content is pragmatic, as knowledge obtained is used to solve problems in daily life. It is presumed that solutions to problems in daily life and society are unique to each region in Mozambique. The content described in the political statement, which respects race and community, is reflected in the objective of mathematics education.

In the analysis of problem situation in the textbook, which is a small structure, the policies of big structure and middle structure are further materialized. The problem situations presented in the 2015 textbook are set in Mozambican towns, industries, and the countryside and pertain to family life. This culminates in equity as it facilitates an understanding of domestic cities, industry, and life. It seeks to enhance inclusion among children by showing different skin and hair colors and the use of wheelchairs in their textbooks. Additionally, topics that include the situation of adult literacy education that are globally discussed are used as problem situations linked to the situation in their own nation.

Consistent discussions have continued in Mozambique since the 1990s to respect, sustain, and develop the culture of each region, which lies at the core of "equity." Discussions on understanding other nations and regions, and classrooms with a diverse pool of immigrants, as well as the impact of globalization have been taking place world over since the 2000s. Such discussions are not as active in Mozambique. Greater attention is placed more on the local and community levels.

With each revision, the learning content was reduced to ensure that as many children as possible could obtain basic academic capabilities. Whereas the international academic assessment gives assimilation pressure on the curriculum of each nation in the world in the global discourse, Mozambique revises the mathematics curriculum based on data of its own nation, while placing importance on those results. Additionally, global discourses such as inclusiveness is explicitly paid attention in diagrams and pictures in the textbooks, while they are no explicitly described in the political statement.

Table 30. History of the incorporation of equity in Mozambique's mathematics curriculum

Decade	Content
1990s	・Agenda relating to gender, race, and mitigation of poverty are described in the Educational Strategic Plan
2000s	
2010s	・Agenda relating to gender, race, and mitigation of poverty are described in the Educational Strategic Plan ・Diagrams, pictures, and scene of problem taking gender, race, and inclusive into consideration are set textbook in 2015. ・The importance of considering gender, race, and mitigation of poverty were discussed in the mathematics curriculum revision process in 2015

5.1.2 Linguistics: Equity as a means of education

With regard to Linguistics, Portuguese is the medium of instruction for mathematics education from Grade 1 onward in Mozambique. Curricula and textbooks are prepared in Portuguese. Several verification studies on the impact of education in the local language have been implemented since the 1990s. The Projecto de Escolarização Bilingue em Moçambique (PEBIMO or Project of Bilingual Schooling in Mozambique) was implemented from 1993 to 1997 under INDE's leadership. As part of this project, classes use the local language in the first and second grades. Portuguese is used as the second language in Grade 3. From Grade 4 onward, the language shifts entirely to Portuguese. The report published by the Ministry of Education in 1997 showed a decrease in the dropout rates and an increase enrolment rates among girls. It also showed that children had improved in terms of their ability to express themselves and think, in schools that used the local language in the class (MINED1997).

The use of the local language as the medium of instruction was discussed during the 2004 curriculum revision process. Although the demand for bilingual education in rural Mozambique was high, the local bureaus of education established primary schools with the

local language as the medium by themselves without seeking official approval owing to the ambiguous decision of the Ministry of Education on the teaching language. Whereas 20 schools offered bilingual classes in Mozambique in 2008, 81 offered them in 2010 (Sim-Sim, 2010). NGOs have translated mathematics textbooks into 16 local languages (Draisma, 2018). Draisma (2006) conducted an empirical study on the use of local language in teaching mathematics. Bantu, which is a local language in Mozambique, considers five (5) a group, but not ten (10). "6" is expressed by words as "5 and 1" and "7" is "5 and 2". Numbers up to 10 are expressed through the use of one's fingers: 7 is represented by all fingers in one hand and two fingers in the other. The 2015 textbooks expresses numbers from 1 to 10 with fingers, which reflects the use of the local language of Mozambique.

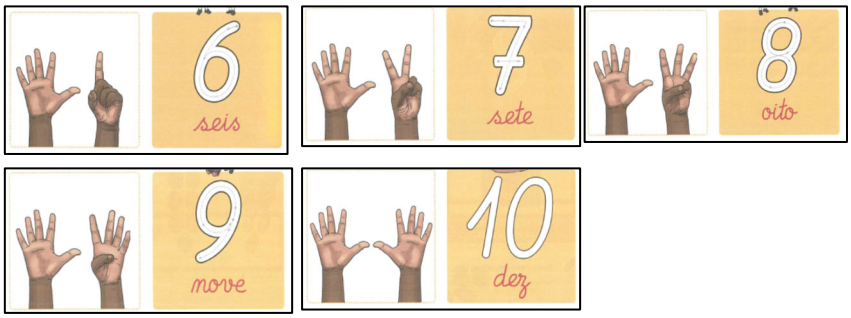


Figure 7. Introduction to numbers in Grade 1 textbook (Fumo. C.et al., 2016)

The Educational Strategic Plan published in 2012 defined Portuguese as the teaching language for basic education and noted that students had to learn Portuguese, one local language, and one international language over 10 years. They seem to attempt multilingual education based on UNESCO's proposal in 1999. It can be regarded that, while placing the highest importance on local viewpoint to promote the measure to use mother tongue as language of instruction in order to improve literacy rate, Portuguese as well as the international official language are taken into consideration with recognition of rapid advance of globalization and internationalization. As pointed out in 4.2, Mozambique have researched the medium of instruction since the 1990s, addressing importance of education with local language. It may be inferred that there was an intention to sustain the original culture of Mozambique in addition to improving the quality of the education.

Table 31. History of the incorporation of linguistics in Mozambique's mathematics curriculum

Decade	Content
1990s	1993-1997: PEBIMO conducted a study on teaching in local languages
2000s	・ Increase in the number of schools that taught in the local language since the 2004 revision ・ Translation of mathematics textbooks into 16 local language by NGOs
2010s	・ Placing importance in five as a unit in revision of textbooks in 2015 ・The Educational Strategic Plan published in 2012 described that "obtain basis to communicate with at least one international official language".

5.1.3 Ethnomathematics: Equity in the educational content

The word of ethnomathematics was not mentioned in the political statement, curriculum, nor textbooks after independence. However, the official documents that were published in 1996 stated the following: "Recognition of cultural diversity in Mozambique and appreciation to it is an asset to ensure identity, and unification and development of the nation. Therefore, better access to value and product of culture of Mozambique, enhancement of knowledge, and diffusion of the culture are aimed" (MINED, 2006;88). The inclusion of 20% of local curriculum was included in curriculum revision in 2004 (MINED, 2012). The Educational Strategic Plan published in 2012 inherited the goal of fostering respect for culture and the viewpoint of values that are rooted in the regions of Mozambique, with rows of phrases relating to the viewpoint of values that have deep roots in Mozambique, such as "respect for others," "respect for the heritage of Africa," and "viewpoint of values of family (MINED, 2012)." Furthermore, the section on the long-term vision for education has the statement: "respect for the fusion of value in the modern society and the heritage of Africa." This is a future-oriented vision that accepts a multicultural society, while respecting the overarching national heritage. It indicates the policy to sustain and inherit diversified cultures that are rooted in each region in Mozambique. The mathematics curriculum has no description relating to contents of the above-mentioned political statement. However, the 2015 textbook embodies the policy to sustain and inherit the local cultures of Mozambique. This policy is described in the political statement, and is set to be achieved by framing problems that include real scenes regarding the national flag, traditional crafts, traditional buildings and ceremonies. The political statement and Mozambique's mathematics

textbooks prioritize the local viewpoint and culture, and not global perspectives**.** Whereas global discourse on global issues often proposes the utilization of ethnomathematics for understanding and acceptance of multi-culture, it can be regarded that political statement and textbooks of Mozambique have only local viewpoint such as sustention and inheritance of culture of own nation.

Table 32. History of the incorporation of "ethnomathematics" in Mozambique's mathematics curriculum

Decade	Content
1990s	1996: Recognition of cultural diversity in Mozambique
2000s	Revision of curriculum in 2004: 20% of local curriculum
2010s	Setting of real situation regarding the national flag, traditional crafts, traditional buildings and ceremonies, in textbooks

5.1.4 Impact of globalization on the sociocultural aspect

Mozambique began to recognize globalization and was influenced by its impact as seen in the Educational Strategic Plan (2012–2016). The political statement prior to that had focused on the domestic component, and used phrases such as "recognition of cultural diversity" and "importance of the diffusion of the culture of Mozambique." However, phrases such as "perception of value in modern society" and "education in a foreign language" were newly inserted in the 2012 Educational Strategic Plan. This had the potential of impacting "linguistics," one of the sociocultural components. Because the 2012 Educational Strategic Plan noted that students had to learn one international language over 10 years. Furthermore, the paragraph of the Long-term Vision of Education has a statement of "respect for fusion of value in the modern society and the heritage of Africa (MINED, 2012, p.15)". This is a future-oriented vision that accepts a multicultural society while respecting Mozambican national heritage. The policy was announced to integrate the local and global perspectives in keeping with globalization while also continuing to respect diverse ethnicities within Mozambique since the 1990s.

The 2012 Educational Strategic Plan prioritized the enhancement of numeracy and continuation of curriculum revisions with the aim of achieving seamless continuity in primary education following the results of SACMEQ III that was implemented in 2007. Content of the Educational Strategic Plan (2012-2016) was proven by explicit statement of discussion with reference to the result of SACMEQ taken into consideration in the curriculum revision in 2015, in the interview with the concerning parties regarding process

of curriculum revision in 2015. Curriculum revisions helped children obtain fundamental knowledge through the reduction of learning content in the early primary grades that was described in Chapter 4. Whereas globalization were recognized since the late 1990s, and caused rapid educational reforms with the integration of international academic assessment and academic standards specified in the economically-advanced nations, Mozambique was outside of that trend. Globalization was recognized in Mozambique since the 2015 curriculum revision. Revisions were conducted based on data accumulated in Mozambique, without any imitation of the curricula of other nations. The three curricula adopted since independence included no concrete perspective or statement on globalization vis-à-vis mathematics education.

For curriculum as a middle structure, the interview for curriculum revision process in 2015 reveals that curriculum revision was conducted based on data accumulated in own country without referring to curriculum of other nations directly, while curriculum of other nations such as Brazil were referred for curriculum revision process in 2004. The textbooks are a small structure that were analyzed in Chapter 4. It is considered that opportunities are given to children to learn about the culture of their own country since only a single question relates to the actual scene of the global context. It is necessary to analyze the textbooks for higher grades that are to be developed in future. On the other hand, it is revealed that pictures inserted in the textbook reflects globalization. For instance, the importance of the inclusiveness has been mentioned in global discourses. Picture of a kid on a wheelchair is included, and students with different color of skin or hair always present (Table 26).

The abovementioned fact means that description of phrases such as “value of modern society” and “education in foreign language” show the awareness of globalization in the Educational Strategic Plan published in 2012. Such facts impact equity and linguistics. It is considered to be a strong influence of the international large-scale assessments, which is presented as a component relating to globalization, since this study found out that the result of SACMEQ has the most impact on the content of revision, in the curriculum revision in 2015. On the other hand, curriculum revisions had taken place based on data drawn from Mozambique and the content were revised to suit the needs of the nation with due respect for global influences.

Table 33. History of the incorporation of globalization in Mozambique's mathematics curriculum

Decade	Content
1990s	No developments
2000s	Referring to curricula from other nations for the 2004 revision.
2010s	・The 2015 revision was based on data drawn from Mozambique. ・Phrases such as "value of modern society" and "education in foreign language" were used in the Educational Strategic Plan published in 2012. ・Placing the highest importance on SACMEQ, for curriculum revision in 2015.

5.2 Comprehensive discussion

To attain equity, the learning content in lower grades were reduced with each revision and shifted to higher grades. These revisions were made with due consideration for the learners based on data accumulated in Mozambique to improve basic numeracy and literacy. It can be regarded that revisions were made based on national data accumulated in the Mozambique and opinion exchange with domestic social and economic entities, as opposed to the while it is an international trend to place importance on relevance relating to global trend, such as peer pressure on mathematics curriculum due to globalization.

In regards to linguistics, while UNESCO held intergovernmental conference, aiming at the establishment of language policy in political and technical aspects globally in 1998, to point out the necessity of enacting clear policy regarding usage and development of mother tongue (UNESCO, 2002a), it can be regarded that Mozambique has attempted to promote education in the local language, by conducting a pilot research in the early 1990s, long before the global discourse. Whereas the world has focused on multilingual mathematics education because of the rise in the number of immigrants following the wave of globalization since the 2000s, Mozambique has not had such discussions. It has focused on developing textbooks and operating schools in local languages in order to focus on the local perspective.

In regards to ethnomathematics, its utilization is for understanding multi-culture in global discourse, due to the trend of globalization since the 2000s. Mozambique does not have a word for ethnomathematics, although local mathematical concepts are used. For example, the numbers from 6 to 10 are expressed as five fingers plus some fingers, respecting the fact that the local language of Mozambique is in the quinary system. Culture and mathematics in other nations are not introduced in the textbooks up to Grade 3. It can be regarded that Ethnomathematics is utilized for understanding culture of the own nation. On the other hand, there is no study material on ethnomathematics itself. Students learn western

mathematics by using content related to their own community or, conversely, by looking for content in their own community that can be linked to universal mathematics. The advantage is that they can understand their own community through western mathematics and, conversely, understand the content of mathematics based on the things that are familiar to them.

Mozambique is a non-federal state and has its own national direction, so it is necessary to have a national policy on how to accept globalization, how to define equity and what kind of educational language policy (linguistics) to adopt. It is also necessary to set certain standards for ethnomathematics (content) as a country. On the other hand, with regard to localization, 20% of the total number of mathematics lesson hours are set aside as local curriculum content-related to each community is allowed to be dealt with freely.

The most significant characteristics of Mozambique with reference to the flow of global discourse is there was less discussion in global viewpoint and extremely more discussion in local viewpoint.

As mentioned above, globalization has impact on all of the sociocultural components, and the transition towards global discourse indicates that discussions regarding global viewpoint have become active since the late 1990s, which have given impact on other sociocultural components. However, respect for race and culture of the nation has been consistently emphasized in the political statement such as the Educational Strategic Plan in Mozambique. It can be regarded that they are the basis of equity as an objective of education. On the other hand, the Educational Strategic Plan in 2012 included the phrase of "value of recent society" and mentioned about the result of SACMEQ, for the content relating to global viewpoint. However, it can be regarded that the focus of revision of curriculum in 2015 is still the local viewpoint. The INDE considered children's insufficient achievement of basic academic ability seriously as a result of SACMEQ. As a result, they tried to improve the curriculum based on detailed data that has been accumulated in their own nation.

In contrast to the flow of global discourse, Mozambique have constantly focused on local viewpoint by placing importance on its own culture, language and race. It becomes obvious that, while comparing to the global trends in curriculum revision such as education renovation based on the results of SACMEQ and competency, during analysis of curriculum revision process in 2015, they are not unconditionally incorporated, and the revision was made based on the academic assessment and the interviews of various stakeholders in the educational field implemented by INDE. As a result, four sociocultural components are further discussed, to promote curriculum development that takes the sociocultural aspect of

the homeland into consideration.

The policies of each component are summarized by period in Figure 8. Equity, linguistics, and ethnomathematics have been discussed since the 1990s. However, the focus is very different from what has appeared in global discourse. The discussion in Mozambique paid attention more on the local culture and communities. Mozambique became aware of globalization after the SAQMEC results came out in the 2010s. The global trends have begun to feature at the policy level but have not been actualized in textbooks.

Figure 9 summarizes the relationship among the sociocultural components in Mozambique. The importance of ethnic diversity and domestic region placed in center as equity, and language and ethnomathematics are aligned to this. In addition, even though taking into account global trends and international assessments such as SACMEQ, the emphasis on local contexts is also a key feature which is different from the global discourse. In addition, the result is very different from the trend in global discourses where ethnomathematics is used to promote the teaching of mathematics in local languages and to put more importance on the succeeding knowledge of local communities and traditional cultures.

This dissertation described the mathematics curriculum development in Mozambique as a ‘descriptive’. However, Mozambique’s approach much in contrast to the global trend which accelerates globalization. Therefore, this may therefore be considered as an antithesis of the prescriptive global trend. Table 33 summarizes the characteristics of each structure of the intended mathematics curriculum. As mentioned earlier, the attention is on the local perspectives.

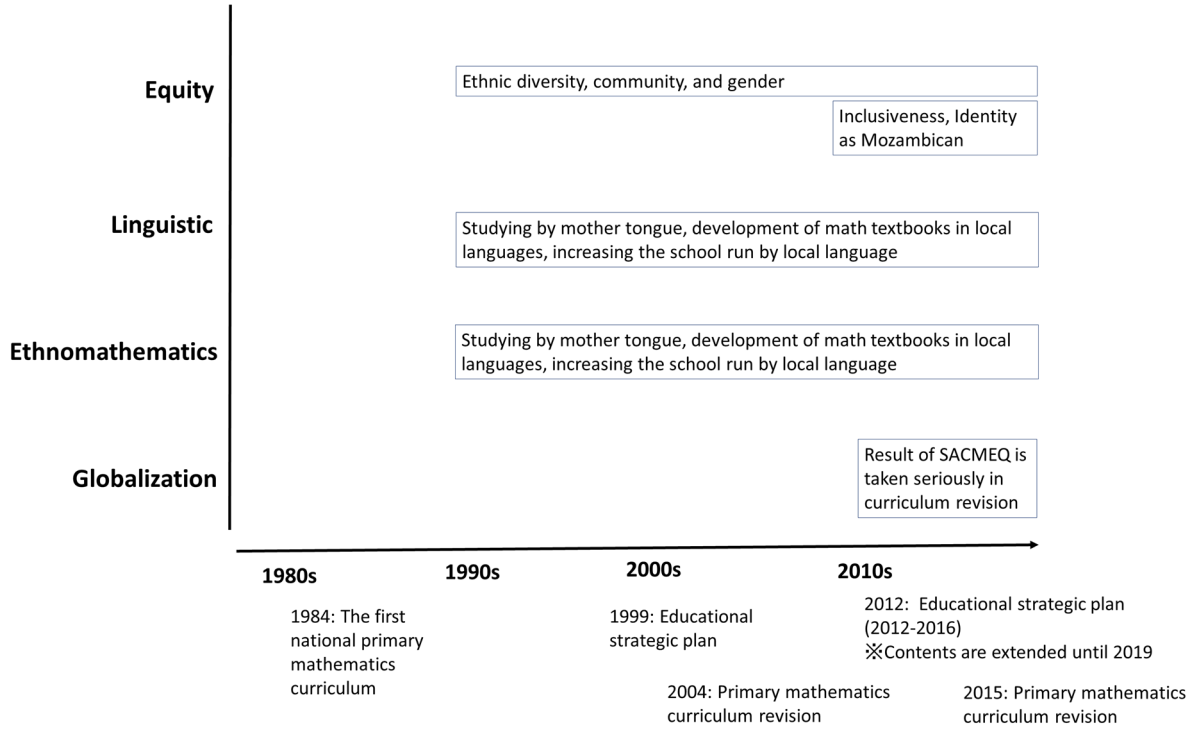


Figure 8 Discussions on the four sociocultural components of the mathematics curriculum in Mozambique

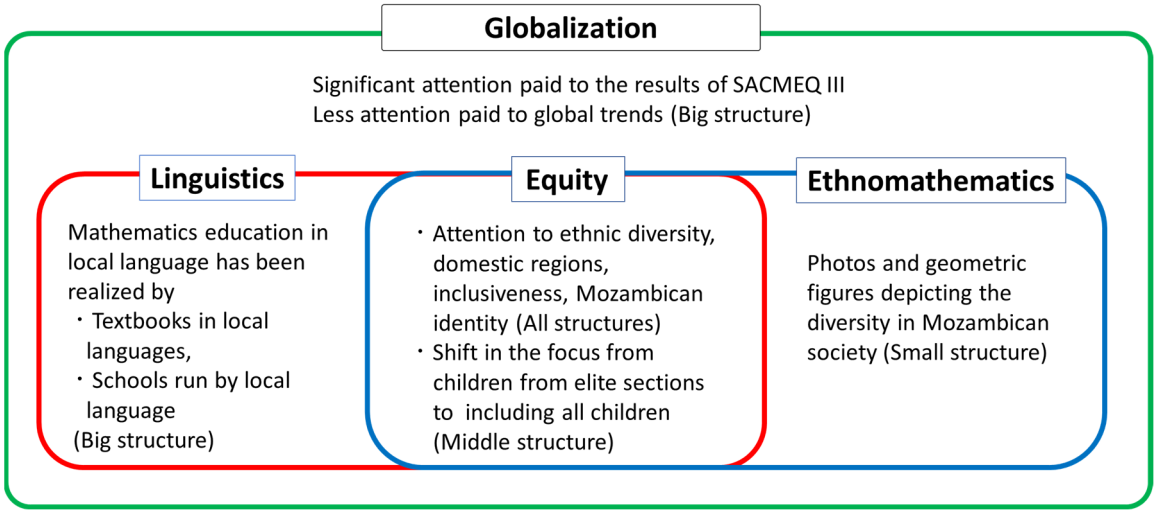


Figure 9. Relationships of four sociocultural components in Mozambique

5.3 Summary of Chapter 5

The characteristics of the sociocultural aspect of the mathematics curriculum development in Mozambique were examined with due reference to global debates. In contrast to global discourses, there has been a significant emphasis on local perspectives in Mozambique for all sociocultural components. The globalization of society has been accompanied by the globalization of education policy since the late 1990s world over. In Mozambique, however, the 2004 curriculum revision included a 20% local curriculum quota. The development of textbooks in local languages made progress since the late 2000s, and the number of schools using local languages has increased.

In addition, it has been pointed out that there is a tendency in global discourses for mathematics curriculum to be standardized in line with globalization. The competencies specified by countries the world over are almost the same as those in Mozambique. On the other hand, in the 2015 revision in Mozambique,, the results of the SACMEQ III were emphasized. However, the content was discussed and revised based on data accumulated within Mozambique. The introduction of financial literacy, which was the subject of much debate globally, was also discussed during the curriculum revision process at the request of social and economic groups in Mozambique. It was also clear that competencies defined by developed countries and international organizations, as well as curriculum of developed countries, were not just accepted as they were, but were rather revised after some discussion in Mozambique. Although at first glance it seems that the mathematics curriculum was revised in line with global debates, a detailed analysis of the curriculum revision process revealed that discussions and evidence were accumulated to recontextualize international debates to suit the local situation in Mozambique. The effort to gather and recontextualize the global discourse became a part of the globalization process.

CHAPTER 6
SUMMARY OF THE STUDY AND WAY FORWARD

This study aimed to (1) identify a framework for the sociocultural aspect of mathematics curriculum development and (2) analyze the characteristics of the sociocultural aspect of Mozambique's national mathematics curriculum development based on the framework. This chapter summarizes the study and describes the way forward. Section 1 provides an overview and the outcomes of each chapter. Section 2 describes the way forward.

6.1 Summary of the study

This study has three major outcomes. First, four major components of the sociocultural aspect of mathematics curriculum development were derived from previous studies and the relationships among them were clarified. Second, a method of analyzing the intended mathematics curriculum from sociocultural aspect was developed. Third, the characteristics of the sociocultural aspect of Mozambique's mathematics curriculum development were clarified. The three main outcomes were summarized by answering the four research questions framed for this study.

6.1.1 Overviews and outcomes of respective chapters

The following research questions were asked to achieve the aims of this study.

(i) What is the sociocultural aspect of mathematics curriculum development? What are its major components? (Chapter 2)

(ii) How is the mathematics curriculum development analyzed from a sociocultural perspective? (Chapter 3)

(iii) What is the status of Mozambique's mathematics curriculum development? (Chapter 4)

(iv) What are the characteristics of Mozambique's mathematics curriculum development with reference to global discourses? (Chapter 5)

(1) Outcomes for research question (i) (Chapter 2)

The sociocultural aspect of mathematics curriculum development was defined and concrete sociocultural components were identified. Furthermore, a meta-analysis was conducted to understand the four sociocultural components using two journals, namely ESM

and JRME, which have the highest impact factor among the academic journals that have uniform treatment of content relating to mathematics education to analyze trend of study from the 1980s to nowadays.

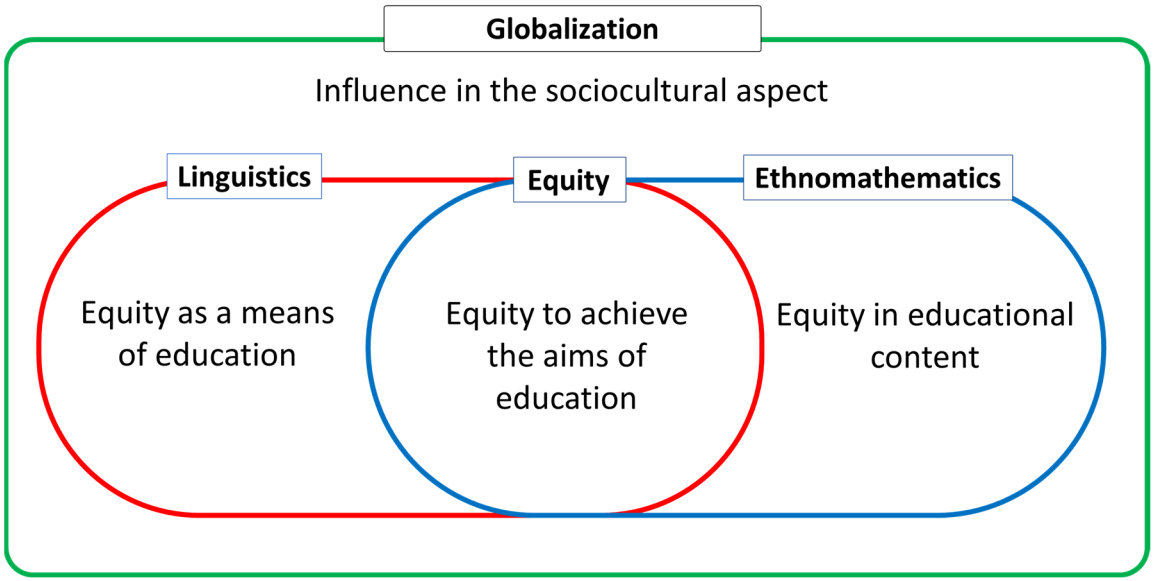
1) Definition of the sociocultural aspect of mathematics curriculum

The sociocultural aspect was divided into the social and cultural aspects. The five levels of mathematics education from Bishop (1991) and the sociocultural model for mathematics education from Khoon et al. (2010) were relied on in this study. The cultural aspect implies that which has been formed and rooted for a long time in the nation and region. The social aspect evolved as a fundament of the cultural aspect and changes under the influence of politics and ideological elements of the society from time to time. Thus, the sociocultural aspect was defined as the integration of the cultural aspect that is formed and rooted in the country with the social aspect that is shaped based on the cultural aspect. In this study, we called them sociocultural aspect of mathematics curriculum as a whole. It includes the components that have been formed by groups within society or that are influenced by external factors, as well as components that are inherent in the mathematics curriculum. Items constituting the sociocultural aspect were called sociocultural components.

2) The sociocultural components focused in this study

The sociocultural components were examined in this study. Four components, namely "Equity," "Linguistics," "Ethnomathematics," and "Globalization" were derived from Baba and Gonzalez (2016). Meta-analysis was conducted on two journals, ESM and JRME, which had the highest impact factor among the academic journals that have uniform treatment of content relating to mathematics education for these four sociocultural components to clarify trend of study from the 1980s to nowadays. Furthermore, the respective components were not independent. The following relationship was found: to achieve equity which is the equity for educational aims, 'linguistics, which is a means of education, and ethnomathematics, which is the content of education should be appropriately placed. Globalization covers the three sociocultural components and affects all of them.

Relationship among four sociocultural components (Reshown Figure 4)



(2) Outcomes for research question (ii) (Chapter 3)

A methodology for analyzing the mathematics curriculum was developed. First, the target and focus were clarified based on the structure of the intended curriculum as spelled out by Baba (2011). The following materials were selected as concrete targets of analysis:

- For the big structure: Educational policy documents since the 1990s and the three curricula crafted since independence (1984, 2004, and 2015).
- For the middle structure: Mathematics syllabus.
- For the small structure: Textbooks for Grade 3, from 2004 and 2015.

The curriculum development was analyzed from both curriculum (product) and revision process (process). A framework to analyze the process of curriculum revision was also established.

Analytical framework of intended mathematics curriculum in this study (Reshown Table 13)

Structure	Content
Big Structure (Basic structure)	Educational stage, subject, and grade: This covers the educational stage and subjects such as the primary, lower and upper secondary education levels, among other things. Most countries have introduced grade systems, but there are some that have structures that merge several grades like Australia and the US.
Middle Structure (Inter-Unit Relations)	Domains and relationships among units: This comprises educational content. There are cases where 'Unit' appears directly on the syllabus and does not so. When it does not, it is expressed in more spreading expression, and more than one unit are enclosed in it, and a strong relationship among them are suggested. It is called the domain.
Small Structure (Intra-Unit Relations)	Intra-Unit: A structure that effectively arranges concepts, ideas, calculation methods, etc., are dealt within units. They are not directly written into the curriculum. Textbook writers and developers of teaching materials decide what to include based on the philosophy and purpose of the curriculum.

Source: Baba(2010)

Analytical framework of intended mathematics curriculum revision process (Reshown Table 14)

	Material analyzed	**Focus of analysis**
Big	- Written educational policy documents (published from 1990 onward) - Objectives of mathematics education in the syllabus (1984, 2004, and 2015)	- Educational vision and its rationale - Objective of mathematics education and its rationale
Middle	- Primary mathematics syllabus (1984, 2004, and 2015; structure of the syllabus and learning content)	- Structure of the mathematics syllabus - Learning content and their sequence
Small	- Textbook (2004 and 2015, Grade 3 textbook)	- Percentage of problems related to the real-world (Kusaka,2020) - Problem setting related to the real-world (Nagasaki, 2000) - Photos, diagrams, and pictures used for the settings (An & Hao, 2011)

Source: developed by author

(3) Outcomes for research question (iii) (Chapter 4)

1) Emphasis on the importance of the inheritance of their own culture

Importance in the Mozambique curriculum development was placed on the inheritance of their own culture from the big to the small structures consistently since independence. Educational policies in Mozambique took diversity in race and language into consideration from independence to date, as the analysis of the political statements showed. These facts can be regarded as "equity" of the objective of mathematics education in Mozambique. While improvement in basic numeracy and literacy was a major objective following the international large-scale assessments in the 2015 revision process, discussions proceeded based on local data from Mozambique rather than on global trends and advanced nations' narratives. The first government-designated textbooks in Mozambique were developed in 2015. The content changed significantly since 2004, and importance was placed on their own culture, compared to the textbooks in 2004. Names of actual local places are presented in the problems relating to agriculture, fishery and industry, along with a number of photographs. In the learning of numbers for Grade 1, the numbers from 5 to 10 are presented as five fingers plus some fingers, which indicates the incorporation of the local counting ideas into the curriculum.

2) Emphasis on learner's equity

Learning content for the lower grades were reduced with each revision and heavier loads were shifted onto the higher grades. These revisions took the appropriate time of the learning into consideration in order to help them improve their basic numeracy and literacy skills. Furthermore, in the textbook, a number of situations which may be relevant after graduation are presented, such as market trading prices, hourly wages, agriculture, fishery, and industry.

(4) Outcomes for research question (iv) (Chapter 5)

The characteristics of the sociocultural aspect of mathematics curriculum development in Mozambique were examined with reference to global discourses. The following findings were drawn.

1) Emphasis on the local viewpoint

The most obvious characteristics compared to the global discourse is to place importance on the local perspective. Globalization has brought about the globalization of educational policies after the later 1990s. However, it can be regarded that Mozambique has

trends such as to establish 20% of local curriculum in the 2004 curriculum revision, and to increase the number of schools that use local language for teaching by developing textbooks in the local language, which is reverse to the global trend.

2) Curriculum revisions based on locally gathered data.

Global discourses pointed out the trend of unifying mathematics curricula. In addition, competencies specified in nations have become almost the same. On the other hand, Mozambique revised its curriculum by relying on local data while also placing importance on the SACMEQ III results in 2015. They introduced financial literacy as a component in the curriculum based on suggestions from social and economic groups. Curriculum was revised upon certain level of discussion in the own nation without direct acceptance of competency that is specified by the developed countries and international organizations.

6.1.2 Proposal for mathematics curriculum development in developing countries

In light of the results of this study, the following describe two points; (1) Curriculum development that places importance on localness of sociocultural aspect, and (2) Country's ownership of curriculum development, as a proposal to mathematics curriculum development in the developing nation.

(1) Curriculum development that places importance on the localness of the sociocultural aspect

This study marshalled four sociocultural components. Placing importance on global perspectives gained significance in the latter half of the 1990s in global discourses. On the other hand, in Mozambique, global trends were applied to the local perspective, to place importance on the local perspective at the policy document level. These are embodied in textbooks. Chapter 2; Transition of curriculum development in the developing nations, describes the tendency of direct emulation of curricula of other nations or the global trend, due to globalization and the lack of their own mathematics education experts in recent mathematics curriculum developments in the developing nations. However, as analysed in chapter 4, it was revealed that Mozambique promoted revisions in 2015, through discussions based on accumulated data by placing importance on its own sociocultural aspect. Although the global viewpoint should not be ignored in the flow of rapid globalization, curriculum revision should be advanced with a concept that global discourse is enabled based on local basis. The technical officers of mathematics education involved in curriculum revision

should constantly collect information on international trends and critically capture them by comparing them to the domestic situation. As a result, a curriculum not only in line with international trends but also in line with the domestic situation is developed. It is the concept that incorporates global trends on the basis of their own situation by thoroughly addressing the sociocultural aspects of their own nation.

(2) Country's ownership of curriculum development

From the course of analysis of revision process of mathematics curriculum development in Mozambique, the curriculum was revised in 2004 with consultants of other nations and referring to curriculum of other nations. In 2015 curriculum revision even though, the international experts contributed to the revision, it was done mainly by themselves based on data accumulated by their own nation. It can be regarded as the stage to terminate the vicious circle, that copies overseas curriculum due to the lack of own experts for mathematics education, which then causes the inability to develop experts of one's own country. In this manner, promotion of ownership of the country enables the realization of curriculum development that places importance on the localness of sociocultural aspect. The reverse is also true, that realizing curriculum development that places importance on localness of sociocultural aspect promotes the ownership of the curriculum. In order to realize it, accumulation of own data regarding education, such as periodical assessment of children, and periodical surveys to teachers, parents and social economic entities as in Mozambique are important.

6. 2 Limitations of this study and recommendations for future research

This study has some limitations. These limitations are explained and discussed with recommendations for future research.

(1) Further research on "Equity" in mathematics education

The first limitation is the classification of the sociocultural components. The author selected four components and identified the relationship among them based on previous studies, namely globalization, equity, linguistics, and ethnomathematics. Individual analyses showed that all sociocultural components are considered alongside equity, which lies at the center of mathematics education. A more specific classification may be possible to allow a deeper analysis of the sociocultural aspect. Equity comprises various elements that differ

across countries. Some are unique to a particular nation or region, and some are global. Although an overview was provided, detailed discussions were not presented. Future research should engage in a detailed discussion of the concepts and capture the global and local perspectives. This will deepen the study of the sociocultural aspect in mathematics curriculum development.

(2) More case studies from other nations

The characteristics of the sociocultural aspect of mathematics curriculum development in Mozambique were clarified with reference to relevant global discourses. It is necessary to examine case studies from other countries using the same framework as it will highlight various parts of the sociocultural aspect of mathematics curriculum development that has thus far not been examined. These case studies can serve as a reference for other regions and nations so that when a nation or region revises its curriculum, it would be able to refer not only the global discourse, but also to discussions and trends prevailing in particular countries and regions. It would also deepen research on the sociocultural aspect of and endogeneity in mathematics curriculum development in developing countries.

As mentioned in the problem statement, in recent years, the educational trends created by the OECD and developed countries are called global trends, they are taken as if they were absolute universal. We must take a critical look at these recent trends.

The content of mathematics itself can be said to be universal. On the other hand, the educational trends created by the OECD and other developed countries can be considered global, but they are not absolutely universal like the mathematics itself. Based on this view, the author focused on the sociocultural aspect of mathematics curriculum development. This study identified specific components of sociocultural aspect of mathematics curriculum development based on previous research and clarified the relationships among them. Furthermore, the characteristics of mathematics curriculum development of Mozambique were identified with reference to global trends.

The final goal is to achieve endogenous development of mathematics curriculum development in developing countries. In this sense, the clarification of the current status of mathematics curriculum development in Mozambique from the sociocultural aspect is a significant first step toward the goal. As a next step, it is necessary to clarify the meaning and value of localisation specifically as opposed to globalization, which has been increasingly promoted recently. The localisation of mathematics curriculum development

will not only be the antithesis of globalization but will also create a synthesis by relating it to the sociocultural aspect of implemented curriculum, which has already been the subject of much research.

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Appendix 1. Articles of ESM

Equity

Year	Title	Authors
1985	Explaining sex-related differences in mathematics: Theoretical models	Gilah Leder
1985	Sex-related differences in mathematics: An overview	Gilah Leder
1986	Selection of mathematically talented students	Barry V. Kissane
1988	Gender differences in mathematical performance	Cathy W. Hall and Cynthia Hoff
1989	Gender differences in the junior secondary (grade 7) mathematics curriculum in Hong Kong	K. C. Cheung
1990	The influence of socio-economic status, entry style and instructional variables on the learning of mathematics in a neo-literate society	Gurcharn S. Kaeley
1991	Interaction and gender — Findings of a microethnographical approach to classroom discourse	Helga Jungwirth
1993	Results of an empirical study into gender differences in attitudes towards mathematics	Gabriele Kaiser-Messmer
1994	Gender differences in mathematics education in Zambia	Roy Sayers
1995	Mathematics achievement and gender: A longitudinal study of selected cognitive and affective variables [grades 6–12]	Lindsay Anne Tartre and Elizabeth Fennema
1995	Gender and the relationship between affective beliefs and perceptions of grade 7 mathematics classroom learning environments	Helen J. Forgasz
1995	Gender interaction in mathematics classrooms: Reflection and transformation	James K. Taole, Marlies Zonneveld and Lebohang Letsie-Taole
1995	The construction of gender, social class and mathematics in the classroom	Bill Atweh and Tom Cooper
1996	Gender, self-concept and teachers of mathematics: Effects on attitudes to teaching and learning	Joe Relich
1997	Gender Differences on the Math Subtest of the Scholastic Aptitude Test may be Culture-Specific	James P. Byrnes, Li Hong & Shaoying Xing
1998	Differential effectiveness by gender of instructional methods on achievement in mathematics at tertiary level	O. A. Adedayo
1999	Keitel, C. (ed.), Social Justice and Mathematics Education	Barbara Allen
2000	Gender-related beliefs of teachers in elementary school mathematics	Joachim Tiedemann
2002	Teachers' Gender Stereotypes as Determinants of Teacher Perceptions in Elementary School Mathematics	Joachim Tiedemann
2004	Student Views of Computer-Based Mathematics in the Middle Years: Does Gender Make a Difference?	Colleen M. Vale and Gilah C. Leder
2005	Assessing Development in Numeracy of Students from Different Socio-Economic Areas: A Rasch Analysis of Three Fundamental Tasks	Kathryn C. Irwin and R. John Irwin
2009	Success in mathematics within a challenged minority: the case of students of Ethiopian origin in Israel (SEO)	Tiruwork MulatAbrahamand ArcaviAbraham Arcavi
2011	Pathways to equity in mathematics education: how life experiences impact researcher positionality	Mary Q. Foote and Tonya Gau Bartell
2012	Seeing culture and power in mathematical learning: toward a model of equitable instruction	Victoria M Hand
2013	Gender differences in both tails of the distribution of numerical competencies in preschool children	Jan Lonnemann, Janosch Linkersdörfer, Marcus Hasselhorn and Sven Lindberg
2014	Public views on the gendering of mathematics and related careers: international comparisons	Helen Forgasz, Gilah Leder and Hazel Tan
2017	Mathematics education in Lebanon: gender differences in attitudes and achievement	Ketty M. Sarouphim and Madona Chartouny
2018	Gender equity in mathematical achievement: the case of China	Yan Zhu, Gabriele Kaiser and Jinfa Cai
2019	Inclusion in mathematics education: an ideology, a way of teaching, or both?	
2014	Teaching mathematically talented students: a cross-cultural study about their teachers' views	Shayshon, Bruria; Gal, Hagar; Tesler, Bertha; Ko, Eun-Sung
2016	Ethical dimensions of mathematics education	Mark Boylan

Linguistics

Year	Title	Authors
1981	Relationships between mathematics achievement and various English language proficiencies	Raymond A. Zepp
1982	Bilinguals' understanding of logical connectives in English and Sesotho	Raymond A. Zepp
1982	Learning mathematics in a second language: A problem with more and less	John W. Berry
1983	Mathematics achievement, language and cognitive development: Classroom practices in Papua New Guinea	Randall J. Souviney
1983	Bilingualism and mathematical reasoning in English as a second language	Lloyd Dawe
1985	Second language teaching through maths — learning maths through a second language	Safder Alladina
1987	Linking logo, levels and language in mathematics	A. T. Olson, T. E. Kieren and S. Ludwig
1987	Common logical errors in English and Chinese	R. Zepp, J. Monin and C. L. Lei
1990	Language factor: Does it affect children's performance on word problems?	Lawal O. Adetula
1992	Language and mathematics: A comparison of bilingual and monolingual students of mathematics	Philip C. Clarkson
1994	Creating and knowing mathematics through language and experience	Tony Brown
1996	The influence of English-Korean bilingualism in solving mathematics word problems	Woo-Hyung Whang
2000	Between languages and discourses: Language practices in primary multilingual mathematics classrooms in South Africa	Mamokgethi Setati & Jill Adler
2000	Language in Use in Mathematics Classrooms: Developing Approaches to a Research Domain	Candia Morgan
2001	Teaching Mathematics in Multilingual Classrooms	Núria Gorgorió & Núria Planas
2003	Patterns of attention in the interaction of a primary school mathematics student with English as an additional language	Richard Barwell
2003	On the epistemological limits of language: Mathematical knowledge and social practice during the renaissance	Luis Radford
2006	Australian Vietnamese Students Learning Mathematics: High Ability Bilinguals and Their Use of Their Languages	Philip C. Clarkson
2006	Comparative Mathematical Language in the Elementary School: A Longitudinal Study	Elizabeth Warren
2007	Language and Culture in Mathematics Education: Reflections on Observing a Romany Class in a Greek School	Charoula Stathopoulou and Fragiskos Kalabasis
2007	Multiple language use and mathematics: Politicizing the discussion	Eric Gutstein
2007	Using Two Languages When Learning Mathematics	Judit Moschkovich
2008	The language of mathematics: Telling mathematical tales.	Bill Barton
2009	The relationship between performance on mathematical word problems and language proficiency for students learning through the medium of Irish	Máire Ní Ríordáin and John O'Donoghue
2011	Geometry, subjectivity and the seduction of language: the regulation of spatial perception	Tony Brown and David Heywood
2012	Differentially positioned language games: ethnomathematics from a philosophical perspective	Gelsa Knijnik
2012	Natural language as a tool for analyzing the proving process: the case of plane geometry proof	Elisabetta Robotti
2013	Almost 20 years after: Developments in research on language and mathematics. Review of J. N. Moschkovich (Ed.) (2010)Language and mathematics education: Multiple perspectives and directions for research	Anna Sfard
2013	Learning to solve addition and subtraction word problems in English as an imported language	Debbie Bautista Verzosa & Joanne Mulligan
2014	One speaker, two languages: Learning opportunities in the mathematics classroom	Núria Planas
2016	The interplay between language, gestures, dragging and diagrams in bilingual learners' mathematical communications	Oi-Lam Ng
2018	Language as resource: a key notion for understanding the complexity of mathematics learning	Núria Planas
2018	Discourse competence as important part of academic language proficiency in mathematics classrooms: the case of explaining to learn and learning to explain	Kirstin Erath, Susanne Prediger, Uta Quasthoff & Vivien Heller
2019	Exploratory mathematics talk in a second language: a sociolinguistic perspective	Sally-Ann Robertson & Mellony Graven

Ethnomathematics

Year	Title	Authors
1996	Making sense of ethnomathematics: Ethnomathematics is making sense	Bill Barton
1997	The End of Innocence: A Critique of 'Ethnomathematics'	Renuka Vithal & Ole Skovsmose
2002	Where would formal, academic mathematics stand in a curriculum informed by ethnomathematics? A critical review of ethnomathematics	Stuart Rowlands and Robert Carson
2003	A Comment on: Rowlands & Carson ``Where would formal, academic mathematics stand in a curriculum informed by ethnomathematics? A critical review''	Shehenaz Adam, Wilfredo Alangui and Bill Barton
2004	Our response to Adam, Alangui and Barton's ``A Comment on Rowlands & Carson `Where would Formal, Academic Mathematics stand in a Curriculum informed by Ethnomathematics? A Critical Review'"	Stuart Rowlands and Robert Carson
2010	Discussing a philosophical background for the ethnomathematical program	Denise Silva Vilela
2011	Criticisms and contradictions of ethnomathematics	Alexandre Pais
2011	Politics in an Indian canyon? Some thoughts on the implications of ethnomathematics	Rik Pinxten & Karen François
2012	Differentially positioned language games: ethnomathematics from a philosophical perspective	Gelsa Knijnik

Globalization

Year	Title	Authors
1990	Global perspectives in the mathematics classroom	Brian Hudson
1992	The Third International Mathematics and Science Study (TIMSS): A brief introduction	David F. Robitaille and J. Stuart Donn
2001	Junior high school students' construction of global views of data and data representations	Dani Ben-Zvi and Abraham Arcavi
2002	Too much is not enough Teaching maths through useful applications with local and global perspectives	Claudi Alsina
2009	The role of contextual, conceptual and procedural knowledge in activating mathematical competencies (PISA)	César Sáenz
2012	Pedagogical content beliefs: global, content domain-related and situation-specific components	Sebastian Kuntze
2014	The PISA mathematics regime: knowledge structures and practices of the self	Clive Kanes, Candia Morgan and Anna Tsatsaroni
2014	PISA, TIMSS and Finnish mathematics teaching: an enigma in search of an explanation	Paul Andrews, Andreas Ryve, Kirsti Hemmi & Judy Sayers
2014	Adult numeracy and the totally pedagogised society: PIAAC and other international surveys in the context of global educational policy on lifelong learning	Anna Tsatsaroni & Jeff Evans
2014	Mathematical images in advertising: constructing difference and shaping identity, in global consumer culture	Jeff Evans, Anna Tsatsaroni and Barbara Czarnecka
2017	A closer look at bilingual students' use of multimodality in the context of an area comparison problem from a large-scale assessment	Anthony Fernandes, Leslie H. Kahn & Marta Civil
2019	Book Review: Numeracy as social practice. Global and local perspectives. Keiko Yasukawa, Alan Rogers, Kara Jackson, & Brian V. Street (Eds.) (2018) Numeracy: the new kid on the block?	Anke Grotlüschen & Klaus Buddeberg

Appendix 2. Articles of JRME

Equity

Year	Title	Authors
1980	Sex differences in high school students' causal auributions of performance in mathematics.	Patricia L. Wolleat, Joan Daniels Pedro, Ann DeVaney Becker and Elizabeth Fennema
1980	Increasing women's participation in mathematics: An intervention study.	Elizabeth Fennema, Patricia L. Wolleat, Joan Daniels Pedro and Ann DeVaney Becker
1980	Sex differences in ftrst·year algebra.	Jane O. Swafford
1981	Mathematical preparation versus careet aspirations: Sex-related dilferences among college· bound Wyoming high school seniors	Melfried Olson and Bob Kansky
1982	Effective Mathematics Instruction for Low-Income Students: Results of Longitudinal Field Research in I 2 School Districts	Douglas Carnine and Russell Gersten
1982	Correlates and Predictors of Women's Mathematics Participation	Jane M. Armstrong and Richard A. Price
1982	Discriminating Factors and Sex Differences in Electing Mathematics	Teri Hoch Perl
1983	Sex Differences in Mathematical Errors: An Analysis of Distracrer Choices	Sandra P. Marshall
1983	Male-Female Enrollment across Mathematics Tracks in Predominantly Black High Schools.	Cora Bagley Marrett and Harold Gates
1984	Sex Differences in a Causal Model of Mathematics Achievement.	Corinna A. Ethington and Lee M. Wolfle
1984	Issues in Mathematics Education for Native Americans and Directions for Research.	Claudette Bradley
1984	Increasing the Participation of Native Americans in Mathematics	Helen Neely Cheek
1984	Monitoring the Mathematics Achievement of Black Students.	Lyle V. Jones, Nancy W. Burton and Ernest C. Davenport, Jr.
1984	Influences on the Learning and Participation of Minorities in Mathematics	Westina Matthews
1984	The Third National Assessment: Minorities and Mathematics.	Westina Matthews, Thomas P. Carpenter, Mary Montgomery Lindquist and Edward A. Silver
1984	The Mathematics Education of Asian Americans	Sau-Lim Tsang
1984	Underachievement and Undcrrepresentation of Hispanics in Mathematics and Mathematics-Related Careers.	Leonard A. Valverde
1984	A Model to Help Minority rudenrs Prepare for mathemarics-Based Careers.	Lucille Croom
1986	Sex Differences in the Mathematics Achievement of Eighth Graders in Ontario.	Gila Hanna
1987	Sex difference in the association between secondary students' attitude towards mathematics and computer	Betty Collis
1987	The influence of mathematics test scores by ethnicity and sex, of prior achievement and highschool mathematics course	Jones, Lyle V.
1987	Sex and ethnic group differences in mathematics achievement: results from the national longitudinal study	Elsie G. J. Moore and A. Wade Smith
1987	Sex-related differences in expectations of success in undergraduate mathematics	Roberta Mura
1988	Sex Differences on New York State Regents Examinations: Support for the Differential Course-Taking Hypothesis	Stuart E. Smith and William J. Walker
1988	Race, Sex, Socioeconomic Status, and Mathematics.	Laurie Hart Reyes and George M. A. Stanic
1989	Sex of Student, and Confidence in Learning Mathematics.	Laurie E. Hart
1990	Classroom Processes, Sex of Student, and Confidence in Learning Mathematics	Battista, Michael T
1990	Gender Differences in Mathematics: An International Perspective	Corinna A. Ethington
1990	The influence of socio-economic status, entry style and instructional variables on the learning of mathematics in a neo-literate society	Gurcharn S. Kaeley
1992	Gender Differences in a Pychological Model of Mathematics Achevement	Corinna A. Ethington
1992	Thinking More Politically About the Challenges Before Us: A Re,ponsc to Romberg.	Michael W. Apple
1996	Gender-Related Differences in Self-Referenced Cognitions in Relation to Mathematics.	Gerard Seegers and Monique Boekaerts
1997	The Construction of the Social Context of Mathematics Classrooms: A Sociolinguistic Analysis	Bill Atweh, Robert E. Bleicher and Tom J. Cooper
1997	Race-Ethnicity, SES, Gender, and Lanuage Proficiency Trends in Mathematics Achievement: An Update	William F. Tate
1999	Gender Differences in First-Grade Mathematics Strategy Use: Parent and Teacher Contributions	Martha Carr, Donna L. Jessup and Diana Fuller

2000	On the Complexity of Schools in Contemporary Society: How Can Research Inform Us About Mathematics Learning and Teaching?	Research Advisory Committee
2000	An Analysis of Development of Sociomathematical Norms in One First-Grade Classroom	Kay McClain and Paul Cobb
2001	Spatial-Mechanical Reasoning Skills Versus Mathematics Self-Confidence as Mediators of Gender Differences	M. Beth Casey, Ronald L. Nuttall and Elizabeth Pezaris
2001	A Foucauldian Gaze on Gender Research: What Do You Do When Confronted With the Tunnel at the End of the Light	Margaret Walshaw
2002	Learning From Teaching: Exploring the Relationship Between Reform Curriculum and Equity	Boaler, Jo
2003	Teaching and Learning Mathematics for Social Justice in an Urban, Latino School	Eric Gutstein
2005	Equity in School Mathematics Education: How Can Research Contribute?	Eric Gutstein, James T. Fey, M. Kathleen Heid, Iris DeLoach-Johnson, James A. Middleton, Matthew Larson, Barbara Dougherty and Harry Tunis
2006	A Closer Look at Gender in NAEP Mathematics Achievement and Affect Data: Intersections with Achievement, Race/Ethnicity, and Socioeconomic Status	Rebecca McGraw, Sarah Theule Lubienski and Marilyn E. Strutchens
2007	Mathematics Teachers, Reform, and Equity: Results from the Brazilian National Assessment	Creso Franco, Paola Sztajn and Maria Isabel Ramalho Ortigão
2010	Research Commentary: Toward Clarifying the Meanings of Gender in Mathematics Education Research	Suzanne Damarin and Diana B. Erchick
2013	Girls' and Boys' Mathematics Achievement, Affect, and Experiences: Findings From ECLS-Kjournals	Sarah T. Lubienski, Joseph P. Robinson, Corinna C. Crane and Colleen M. Ganley
2013	One Size Does NOT Fit All: Achieving Equity in Māori Mathematics Classrooms	Tamsin Meaney, Tony Trinick and Uenuku Fairhall
2013	Learning to Teach Mathematics for Social Justice: Negotiating Social Justice and Mathematical Goals	Tonya Gau Bartell
2013	Negotiating Social Justice Teaching: One Full-Time Teacher's Practice Viewed From the Trenches	Susan A. Gregson
2013	Introduction to the JRME Equity Special Issue	Beatriz D'Ambrosio, Marilyn Frankenstein, Rochelle Gutiérrez, Signe Kastberg, Danny Bernard Martin, Judit Moschkovich, Edd Taylor, and David Barnes
2016	Research Commentary: Educational Technology: An Equity Challenge to the Common Core	Richard Kitchen and Sarabeth Berk, University of Denver
2017	Equity Within Mathematics Education Research as a Political Act: Moving From Choice to Intentional Collective Professional Responsibility	Aguirre, Julia; Herbel-Eisenmann, Beth; Celedón-Pattichis, Sylvia; Civil, Marta; Wilkerson, Trena; Stephan, Michelle; Pape, Stephen; Clements, Douglas H.
2017	Unpacking the Male Superiority Myth and Masculinization of Mathematics at the Intersections: A Review of Research on Gender in Mathematics Education	Luis A. Leyva
2017	The Culture of Exclusion in Mathematics Education and Its Persistence in Equity-Oriented Teaching	Nicole L. Louie
2017	Toward a Framework for Research Linking Equitable Teaching With the Standards for Mathematical Practice	Tonya Bartell, Anita Wager, Ann Edwards, Dan Battey, Mary Foote, Joi Spencer,
2018	Equity Analytics: A Methodological Approach for Quantifying Participation Patterns in Mathematics Classroom Discourse	Daniel L. Reinholz and Niral Shah
2019	Unpacking the Links Between Equitable Teaching Practices and Standards for Mathematical Practice: Equity for Whom and Under What Conditions?	Filiberto Barajas-López and Gregory V. Larnell
2019	A Qualitative Metasynthesis of Teaching Mathematics for Social Justice in Action: Pitfalls and Promises of Practice	Frances K. Harper

Linguistics

Year	Title	Authors
1983	The Effects of Test Language and Mathematical Skills Assessed on the Scores of Bilingual Hispanic Students	Maria M. Llabre and Gilberto Cuevas
1984	Mathematiclt Learning in English as a Second Language	Gilberto J. Cuevas
1986	Learning numbers: A Linguistic perspectives	Pearla Nesher and Tamar Katriel
1989	Solutions of Simple Word Problems by Nigerian Children: Language and Schooling Factors.	Lawal O. Adetula
1992	Bilingualism and Mathematics Learning:Another Perspective.	Philip C. Clarkson and Peter Galbraith
1997	An Exploration of Aspects of Language Proficiency and Algebra Learning	Mollie MacGregor and Elizabeth Price
1998	Learning to Estimate in the Mathematics Classroom: A Conversation-Analytic Approach	Michael A. Forrester and Christopher D. Pike
2000	Language Development and Concept Flexibility in Dyscalculia: A Case Study	Kristine K. Montis
2005	Teaching Mathematics in a Primary Multilingual Classroom	Mamokgethi Setati
2012	Seeing With Two Eyes: A Teacher's Use of Gestures in Questioning and Revoicing to Engage English Language Learners	Paichi Pat Shein
2013	Mathematics Education and Language Diversity: A Dialogue Across Settings	Mamokgethi Setati Phakeng and Judit N. Moschkovich
2017	What We Say and How We Do: Action, Gesture, and Language in Proving	Caroline (Caro) Williams-Pierce, Elizabeth L. Pier, Candace Walkington, Rebecca Boncoddo, Virginia Clinton, Martha W. Alibali and Mitchell J. Nathan
2019	What You See Is What You Get? Sign Language in the Mathematics Classroom	Christina M. Krause

Ethnomathematics

Year	Title	Authors
1988	The Ethnographic Research Tradition and Mathematics Education Research.	Margaret A. Eisenhart
1998	Mathematics, Culture, and Power--A review of Ethnomathematics: Challenging Eurocentrism in Mathematics Education	Richard S. Kitchen, Joanne Rossi Becker
1995	Cultural Tools and Mathematical Learning	Paul Cobb
1995	Numcracy as Cultural Practice: An Examination of Numbers in Magazines for Children, Teenagers, and Adults	L. Resnick, Anthony J Gabriele

Globalization

Year	Title	Authors
1980	Children's spatial-perceptual preferences: A cross-cultural comparison	Albert O. Shar and William E. Geeslin
1994	An International Perspective on Research Through theJRME.	Ubiratan D'ambrosio and Beatriz D'ambrosio
2004	JRME Goes Global	Edward A. Silver
2004	JRME in the Global Village: Parlez Vous Français? Habla Ud. Español?	Vilma Mesa
2005	Research Commentary: International Comparative Studies in Mathematics Education: Opportunities for Collaboration and Challenges for Researchers	Joan Ferrini-Mundy, William H. Schmidt
2006	Does Eighth-Grade Mathematics Teaching in the United States Align With the NCTM Standards? Results From the TIMSS 1995 and 1999 Video Studies	Jennifer K. Jacobs, James Hiebert, Karen Bogard Givvin, Hilary Hollingsworth, Helen Garnier and Diana Wearne
2016	Who Is Behind the Nationalization of Mathematics Education? A Review of Math Education for America? Policy Networks, Big Business, and Pedagogy Wars	Trevor Warburton , Ed Buendia