Influence of Culture on the Adaptation of Realistic Mathematics Education in Indonesia

By

Shintia Revina

A thesis submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy at the University of Hong Kong

June 2017

Abstract of thesis entitled

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Submitted by
Shintia Revina
for the degree of Doctor of Philosophy
at The University of Hong Kong
in June 2017

This study explores the adaptation of Realistic Mathematics Education (RME) – the Dutch approach to mathematics education – within the Indonesian context and interprets the influence of culture on such transfer of practice. In Indonesia, RME is known as *Pendidikan Matematika Realistik Indonesia* (PMRI), which means the Indonesian adaptation of RME. This study focuses on identifying the features of RME that can be accepted and integrated in various aspects of mathematics education in Indonesia as well as those that have been changed in the process. Emphasis is placed on studying the consistency between RME and exemplary curriculum materials, teachers' attitudes towards teaching and learning mathematics, and teachers' actual teaching practice in Indonesia. This study also compares similar aspects in the Netherlands as a point of reference.

The major findings are as follows: The RME features that can be reflected in the current Indonesian primary mathematics curriculum were limited by the content-oriented approach and by the centralized decision making about the mathematical contents to be covered in the curriculum. The PMRI textbook that was developed to support the implementation of RME in Indonesia has adopted most features of the Dutch RME textbook, except for the differentiated tasks based on different ability levels. The PMRI teachers that had been trained in various RME-related workshops and development programs also generally showed support towards RME ideas. Yet, their

intention to carry out the guidance and interactivity principles suggested by RME was found to be particularly lower than their Dutch counterparts. In their lessons, the PMRI teachers saw RME as able to bring joyful learning as well as to give opportunities for their students to learn both as individuals and through social construction. They also showed awareness of how to use realistic problems and to introduce models and schematization. Nevertheless, the realistic problems were mainly given as application problems rather than as a source for learning mathematics, and the implementation was limited by teachers' dominance and rule-following methods. Unlike the Dutch lessons that are more open to students' engagement and exploration, the Indonesian RME-based lessons were also found to lack horizontal interaction and intertwinement.

In search of explanations for the findings, this study explores the consistencies and inconsistencies between RME and the Indonesian educational culture that is rooted in Javanese tradition. In addition to the cultural aspect, this study also examines the classroom, institutional, and societal aspects as well as the stage of RME development in Indonesia to understand why RME adaptation in this country has departed from its original form. Finally, this study suggests that the role of culture on RME adaptation in Indonesia deserves due attention.

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Declarations

I declare that this dissertation represents my own work, except where due acknowledgement is made, and that it has not been submitted to this or other institution in application for a degree, diploma or any other qualifications.

I also declare that I have read and understand the guideline on “What is plagiarism?” published by The University of Hong Kong (available at http://www.hku.hk/plagiarism/) and that all parts of this work complies with the guideline.

Candidate: **Shintia Revina**

Signature:

Date:

Acknowledgement

This thesis becomes a reality with the kind supports and help of many individuals. I would like to extend my sincere thanks to all of them.

Foremost, I would like to express my gratitude to my supervisor, Professor Frederick K.S. Leung, for his advice and guidance throughout my entire study. This study would not have been accomplished without his inspiring supervision and encouragement.

I would also like to thank to IMPOME alumni and the PMRI teachers in 12 cities in Indonesia, the curriculum developer and textbook writer in Jakarta, as well as the teachers in Utrecht. Without their helps, data collection in this study would have been impossible.

Special thanks should go to drs. Frans van Galen and Dr. Dolly van Eerde in the Freudenthal Institute of Science and Mathematics Education, Utrecht University for their generous helps during my data collection in Utrecht and enlightening ideas throughout the study. My grateful appreciation also goes to Dr. Yansen Marpaung in Sanata Dharma University Yogyakarta, for answering my questions about PMRI and the curriculum development, and to Prof. Zulkardi and Prof. Ratu Ilma in Sriwijaya University South Sumatra, as well as to Dr. Rahmah Johar in Syiah Kuala University Aceh, for their invaluable commentary to this study.

Finally, I would like to express my heartfelt thanks for my beloved and supportive family and friends. I would like to thank my husband for his encouragement and endless patience, and to my mother, my sister, and our big family for their tremendous supports. My appreciation also goes to my friends and colleagues in the Faculty of Education – HKU, particularly those in the Division of Mathematics and Science Education, for their supports and invaluable discussion.

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List of Abbreviation

AVRR	*Attitude Vragenlijst over Rekenen en Rekenonderwijs* (Questionnaire of Teacher' Attitudes towards Teaching and Learning Mathematics)
BSE	*Buku Sekolah Elektronik* (Indonesian School Textbook)
BSNP	*Badan Standar Nasional Pendidikan* (Indonesian Board of National Education Standard)
CHC	Confucian Heritage Culture
DIKTI	*Direktorat Jenderal Pendidikan Tinggi* (General Directorate of Indonesian Higher Education)
DWiG	*De Wereld in Getallen*
GDN	Guidance
IMPOME	International Master Program on Mathematics Education (A collaboration between Freudenthal Institute – Utrecht University, Sriwijaya University and State University of Surabaya)
INT	Interactivity
IOWO	*Instituut Ontwikkeling Wiskunde Onderwijs* (The Institute for the Development of Mathematical Education)
ITN	Teacher Intention
KTSP	*Kurikulum Tingkat Satuan Pendidikan* (Indonesian National Curriculum – 2006 version)
LPTK	*Lembaga Pendidikan Tenaga Kependidikan* (Teacher Education College in Indonesia)
MiC	Mathematics in Context
NCTM	National Council of Teachers of Mathematics

NUFFIC	Netherlands Universities Foundation for International Cooperation (The Netherlands Organisation for International Cooperation in Higher Education)
OECD	Organisation for Economic Co-operation and Development (OECD)
PGSM	*Pengembangan Guru Sekolah Menengah* (Indonesian Secondary Teacher Development)
PISA	Programme for International Student Assessment
PMRI	*Pendidikan Matematika Realistik Indonesia* (Indonesian Adaptation of Realistic Mathematics Education)
Pusbuk	*Pusat Perbukuan* (Indonesian National Textbook Center)
Puskur	*Pusat Kurikulum* (Indonesian National Curriculum Development Center)
Puskurbuk	*Pusat Kurikulum dan Perbukuan* (Indonesian National Curriculum and Textbook Center, since 2012-2013)
RME	Realistic Mathematics Education
SDM	Students' Self -Development
SLO	*Stichting Leerplanontwikkeling* (The Netherlands Institute for Curriculum Development)
TALIS	The Teaching and Learning International Survey
TIMSS	Trends in International Mathematics and Science Study

Chapter 1 – Introduction

1.1 Background and Rationale of the Study

As a result of globalization and in an effort to modernize and improve their educational system, policy makers and educators in many countries tend to look to other countries for educational theory and approaches that are considered as delivering desirable results, and try to adopt these practices in their own countries. Nowadays, this phenomenon is even more prevalent following the results from international assessments such as TIMSS (Trends in International Mathematics and Science Study) and PISA (Programme for International Student Assessment). Some countries have a tendency to mimic the excellent performers at the top of the league table, in the hope that their students would perform as well as those of their counterparts. Some other countries tend to look to their former colonizers for such educational approaches, as the colonial legacy still has an influence in the minds of educational bureaucrats. Through this process, it is often that a certain educational approach, method, model, theory or policy that had originally been developed in a particular culture setting is transferred and applied to another culture (Steiner-Khamsi, 2003, 2004; Andrews, Ryve, Hemmi and Sayers, 2014). To name one notable example, Cooperative Learning, Lesson Study and Realistic Mathematics Education is among the educational methods and approaches that have been highly regarded for delivering desirable results in its country of origin and so inspired educators all over the world (Phuong-Mai, 2008; Fujii, 2014; De Lange, 1996).

Past studies on educational borrowing have actually raised greater caution to the dangers of a simplification of this transfer of practice (Grants, 2000; Morris, 2012; Phuong-Mai, Terlouw and Pilot, 2006; Phuong-Mai, Elliot, Terlouw and Pilot, 2009; Liu and Feng, 2015). These studies criticized the ‘uncritical’ adoption practiced in many countries and challenged the idea that an educational method or approach can truly be universal and implemented across all cultures. They argued that some aspects of the borrowed method might be too closely bound up with the specific context in its original country. Therefore, one cannot simply assume that what has been done successfully in one place would produce similar outcomes elsewhere.

Rose (1991a) pointed out that in adopting policy, theory and practice from other contexts, the significance of culture and the particular context between the involved countries should not be neglected, or it may risk 'false universalism'. Even when an educational method is imported to another country that seems to be ready for such implementation, some inconsistencies caused by cultural factor may still exist. For example, Hertz-Lazarowitz and Zelniker (1995) found some inconsistencies in the adoption of Cooperative Learning, which originated in the United States, to Israel. While one may think the Israeli context is ready to implement an American educational model, Hertz-Lazarowitz and Zelniker (1995) found that some features of Cooperative Learning is incompatible with Israeli educational values. This suggests that cultural factors may play an even more important role when this model is transferred to countries with significant cultural differences.

In mathematics education, the 'false universalism' risk is even higher, as mathematics itself is often regarded as a supposedly 'universal' subject. Atweh and Clarkson (2002, p.9) stated, "in the mind of many, it has achieved a status of an international language independent of cultural affiliation and context of development". In recent years, the debate over what is culture-bound and what is culture-free in mathematics education has actually continued, and resulted in divergent views of educational transfer. In a survey by Clarkson and Atweh (2003), some scholars argued that mathematics is a 'universal' language, and therefore believed educational transfer would be problem-free. In contrast, others contested this mathematics-as-universal viewpoint and raised some concerns about educational transfer practices.

Given this complexity and the increasing trend of ‘borrowing’ in the field, it is surprising to find that the topic of educational transfer has featured infrequently in mathematics education literature, with only a few empirical studies that look particularly at how culture influences the adaptability of the transferred practice. In order to fill this research gap, the present research explores the adaptation of Realistic Mathematics Education (RME) – the Dutch approach to mathematics education – within the Indonesian context. Owing to its colonial history, Indonesia borrowed its early mathematics curriculum from the Netherlands. Through its development, the Indonesian mathematics curriculum has been following the global trends in mathematics education. For example, in the late 1990s, some Indonesian mathematics educators attempted to borrow the Dutch approach to mathematics education, namely the RME, owing to its successful implementation in the Netherlands. RME has been attributed to the excellent performance of Dutch students in international assessments such as TIMSS (van den Heuvel-Panhuizen and Wijers, 2005), and so has inspired mathematics educators in many countries, including Indonesia. In Indonesia, RME has been adapted through the PMRI project (*Pendidikan Matematika Realistik Indonesia*). To overcome the human resource issues when disseminating PMRI in Indonesia – with support from the Indonesian Higher Education Directorate (DIKTI) and Netherlands Universities Foundation for International Cooperation (NUFFIC) – a series of cohorts of scholars travelled to the Netherlands to study RME. These programs were conducted with the expectation that the Dutch-educated scholars would return home and serve as agents to disseminate PMRI in their respective regions. The researcher herself is one of the scholars in the 2010 cohort, and has been part of PMRI local team in Jakarta.

The present study mainly aims to identify the features of RME that can be accepted and integrated in various aspects of mathematics education in Indonesia, as well as those aspects that have been changed through the process. To obtain a holistic picture of the transference of RME in various aspects of mathematics education in Indonesia, this thesis focuses on studying the consistency between RME (Gravemeijer, 1994; van den Heuvel-Panhuizen and Wijers, 2005) and the exemplary mathematics curriculum materials, teacher's attitudes towards teaching and learning mathematics and teacher's instructional practice in Indonesia. The teachers who participated in this study have been trained in various PMRI workshops conducted nation-wide since 2001, and known as PMRI teachers (Hadi, 2012). The fact that the Indonesian and Dutch educational cultures are significantly different urges this study with a necessity to look through a cultural perspective to interpret and explain the findings. In addition, as a comparative perspective often allows one to have a more thorough perspective on the implementation of a borrowed practice, some comparison was conducted with similar aspects in the Netherlands as a point of reference.

1.2 Research Questions

Consequently, the key problem in this research is:

> "If an instructional theory, such as RME, is not truly universal to be implemented across culture, how has RME been adopted in Indonesia? What features of RME can be accepted and integrated into Indonesian educational tradition, and which of its original features have been departed? To what extent do cultural factors influence the adaptation of RME in Indonesia?"

This key problem is structured into the following research questions:

1. How RME principles are reflected in the Indonesian exemplary curriculum materials, and how does this differ from that in the Netherlands?

2. What attitudes towards teaching and learning mathematics do the PMRI teachers uphold? How consistent are their attitudes with the RME principles? How are the attitudes different from that of the Dutch teachers?

3. How do the PMRI teachers implement the RME principles in their classrooms? How is the implementation different from that of the Dutch teachers?

4. How are the PMRI teachers' classroom practices consistent with their attitudes to teaching mathematics?

5. What factors can be accounted to the findings? How does culture influence the implementation of RME in Indonesia?

In regard to research question one, the Indonesian curriculum materials studied include the primary mathematics curriculum guideline that utilized RME as one of its theoretical references during development, the mathematics textbook approved by National Textbook Center, and a textbook called 'PMRI' textbook adapted from the Dutch 'Realistic' textbook. In answering research question two this study administered a survey to the PMRI teachers in 12 cities in Indonesia, and compared the results to that of a similar study conducted earlier in the Netherlands by Verbruggen, Frickel, van Hell and Boswinkel (2007). In regard to research question three and four, the researcher observed PMRI teachers in Jakarta, Indonesia and some teachers that intended to utilize the RME approach in Utrecht, the Netherlands. With the findings on the implementation of RME in various aspects of mathematics education in Indonesia (research question one to four), research question five examines how the findings can be explained, particularly from a cultural perspective. That is to identify the alignment or divergence between the Indonesian educational culture and the RME principles.

1.3 Definition of Culture in this Study

Culture is a crucial concept in this study, as the aim is to draw on cultural factors that might shape the adaptation of RME in Indonesia. However, as culture has been defined in many ways and different points of view, this study may not be able to offer a comprehensive definition of the term. Rather, below is discussed what is meant by 'culture' in this thesis and indicate the efficacy of such approaches.

Past studies have defined culture as a collective of behaviors, values, and norms that have accumulated over time in a particular group (Ratner, 1997; Hofstede, 1980). Ratner (1997, p.93) described culture as a concept that "organize the manner in which people perceive, imagine, think about, remember, and feel about things. In other words, collectively constructed concepts compose culture, and cultural symbols organize psychological phenomena". In his seminal book, Hofstede (1980, p. 25) also defined culture as, "the collective programming of the mind which distinguishes the members of one group from another". Here, the groups may refer to the ethnic groups, nations, or organizations. In comparing values, behaviors, institutions and organizations across nations, Hofstede, Hofstede and Minkov (2010) discussed six cultural dimensions that is unique for a country. This includes Power Distance Index, Individualism, Uncertainty Avoidance, Masculinity, Long Term Orientation and Indulgence dimension of the culture.

Culture has also been specifically discussed within the field of mathematics education. For instance, using the concept of 'subgroups' of each culture – that is the culture adopted in a certain occupation (Hofstede, 1980) – Leung (1992) discussed the 'subgroups' of mathematics education culture in different education systems. In his subsequent works, Leung (Leung, Graf and Lopez-Real, 2006) defined culture as the method of thinking, values, norms and beliefs that are related to education and mathematics education that may differ from one education system to another. In another study, Leung went further to assert that, “the education in a particular social environment is influenced in many ways by the culture of such environment and hence differs across countries or regions with different cultural backgrounds” (Lui and Leung, 2013, p.35).

In addition to cultural aspect, Leung (1992) also discusses the framework by Bishop (1988), which suggests the five levels on the social dimensions of mathematics education. The five levels have to be understood as interwoven dimensions rather than separated and hierarchical. These dimensions are discussed below:

a. Cultural- the level of culture

   At this level, the emphasis is on understanding how the development of the philosophy of learning embedded in culture.

b. Societal - the level of society

   This level specifically refers to the education system in the community.

c. Institutional - the level of school

   Within this level, the factors include policies made by individual schools and structures within a particular school (i.e. the organization of mathematics teaching).

d. Pedagogical - the level of the classroom

   This level includes factors involving the teacher and classrooms.

e. Individual – the level of individual

   This level may include individual learners’ goals and values of learning mathematics.

In this framework, Bishop (1988) further illustrated that a particular society may have some similar practices to shape their societal goals and aspirations. In different education systems, then, practitioners may have their divergent practices that differ from each other. This idea is also in line with Lerman (2000, p.212) who said “mathematics education can look different in different social, economic, and cultural situations”. This implies that the teaching and learning mathematics is not culture-free. Rather, it is closely related to the values and norms hold by the societies where it is being practiced.

In this thesis, the definition of culture by Leung et al. (2006) is adopted. Therefore, the term ‘Indonesian culture’ in this study refers to the methods of thinking, values, norms and beliefs that are related to education (and mathematics education) appreciated in Indonesia. As the foundation for the discussion of the findings, the educational culture in Indonesia that is rooted from Javanese tradition will be depicted in chapter 3. This is followed by a discussion on Hofstede’s six cultural dimensions for Indonesia and the Netherlands. In addition to culture, some possible explanations from other social dimensions of mathematics education as suggested by Bishop (1988), are explored in the conclusion chapter.

1.4 Significance of the Study

This study is theoretically and practically significant. Theoretically, it contributes to the knowledge gap on the complexity of a borrowing practice in mathematics education. This study shows how culture influences the adaptation of a certain approach to mathematics instruction, such as RME, in a foreign setting. Highlighting the significance of different cultures and contexts between the two places where RME has been implemented, this study offers an illustration for the need of a more contextualized approach to mathematics education. This study may also contribute to the knowledge of Indonesian educational culture that is rooted from Javanese tradition, where international audience are so ignorant about.

This study has some practical significance for Indonesia. Firstly, nowadays, Indonesian educators are trying to find an effective educational theory and practice that is culturally relevant. However, instead of developing their own, the educators and practitioners tend to look to other systems for reference. In light of this, the current study aims to analyze the underlying values of the adopted RME theory. This is to learn its compatibility with the values of Indonesian educational culture. Secondly, comparing teachers' attitudes towards teaching and learning mathematics and their actual classroom practice may spur policy makers to follow up on the state of PMRI and take further action.

1.5 Outline of the Thesis

The thesis consists of nine chapters. Chapter one introduces the conceptualization of the study. Chapter two depicts the process of educational borrowing, reviews the literature related to Realistic Mathematics Education as well as the related teachers' attitudes and practice of the approach, and discusses some relevant past studies. Chapter three presents some background information about Indonesia and its culture, particularly focusing on Javanese culture. Chapter four describes the methodology of the study. It includes the description of mixed methods, conceptual framework, data collection, data analysis method, and the results of the pilot study.

Chapter five, six, seven, and eight answer the research questions of the study. Specifically, chapter five focuses on the consistency between RME and the Indonesian primary mathematics curriculum and textbooks. Chapter six reports the results and findings based on an analysis of the PMRI teachers' attitudes data from the questionnaire. Chapter seven provides details about the implementation of RME in the three classrooms in Jakarta, and compares this to similar practices in the three classrooms in Utrecht, The Netherlands. Chapter eight discusses the consistency between teacher beliefs and teaching practice, and includes the results of interviews with the observed teachers. Finally, chapter nine summarizes the major findings, discusses the influence of culture towards the implementation of RME in Indonesia, presents the contributions, implications, as well as the limitations of this study and provides some recommendations for future research.

Chapter 2 – Literature Review

This chapter reviews the literature to define the study in a broader context. Section 2.1 depicts the process of educational borrowing, while section 2.2 reviews the literature on the history, philosophy and characteristics of Realistic Mathematics Education. Section 2.3 explores some studies on the teachers' attitudes towards RME and the classroom practice, and section 2.4 discusses some key relevant studies.

2.1 The Process of Educational Borrowing

In comparative research on education, the term educational borrowing is broadly defined as transplanting, or importing, educational theory or practice that has been developed under a particular context to another context elsewhere (Grants, 2000; Steiner-Khamsi, 2004). The term borrowing itself has often been criticized and alternative descriptors such as adaptation, transfer or assimilation practice have been suggested. In this sense, some research distinguishes between 'borrowed' and 'learned' from others, or between 'adoption' and 'adaptation' practices (Morris, 2012; De Wet and Wolhuter, 2007; Dolowitz and Marsh, 1996). For example, Morris (2012, p.90) defined an educational borrowing as "a rational and objective quest to identify and learn from the evidence concerning the universal features of best practices". He argued that comparative educators actually tend to avoid borrowing and, are very cautious towards its implementation. This was based on the assumption that some of the borrowed theory or practice might be too closely bound up with the specific context of its origin, and so may not be effective if transplanted elsewhere.

Other studies (Phillips and Ochs, 2003, p.451) however, suggest that the term 'borrowing' can be used, "to cover the whole range of issues relating to how the foreign example is used by policy makers at all stages of the processes of initiating and implementing educational change". Yet, they often made further distinctions for different degrees or stages of the transfer practice. According to Rose (1991b), educational borrowing may have different degrees of mutation between the original and the receiving cultures: from copying, emulation, hybridization, synthesis to inspiration. For example, 'copying' occurs when wholesale features of the foreign theory or practice is adopted, while 'emulating' is when some adaptation is made owing to some contextual factors. 'Hybridization', or 'synthesis', occurs when there are efforts to combine the features of the borrowed theory with the current programs in the receiving country, resulting in an original program being created. Finally, 'inspiration' occurs when the efforts result in a fresh program that is expanded and inspired from the original borrowed practice.

Phillips and Ochs (2003) also offered a comprehensive framework to describe educational borrowing that consists of four stages; Cross-National Attraction (Impulses and Externalizing Potential), Decision, Implementation (Adaptation, Suitability of Context, Speed of Change) and Internalization/Indigenization stage (See Figure 2.1). According to this framework, the impulses that trigger borrowing practice vary. It ranges from negative external evaluation (i.e. TIMSS and PISA results), to political configuration (i.e. colonial relationship, globalizing tendencies, international alliances, political change, etc.). In the next stage, the decision stage, the policy makers, or academia with access to advising policy makers, may have various reasons in selecting a particular method or approach to borrow. Such reasons to adopt a method could be the theoretical relevance of the method to the educational goals of the receiving country, its practicality, or simply owing to the enthusiasm of the scholars for the method.

At the most important stage -implementation- the framework stresses the importance of adaptation and appropriation. The degree of adaptation will depend on many contextual factors, and the implementation might have immediate or long-term effects. The significant involved actors of course also play an important role in implementation. These actors include government bodies and educational authorities, school principals, and teachers as the frontline agents of the movement. In this sense, the implementation may receive support, or face opposition from many different parties.

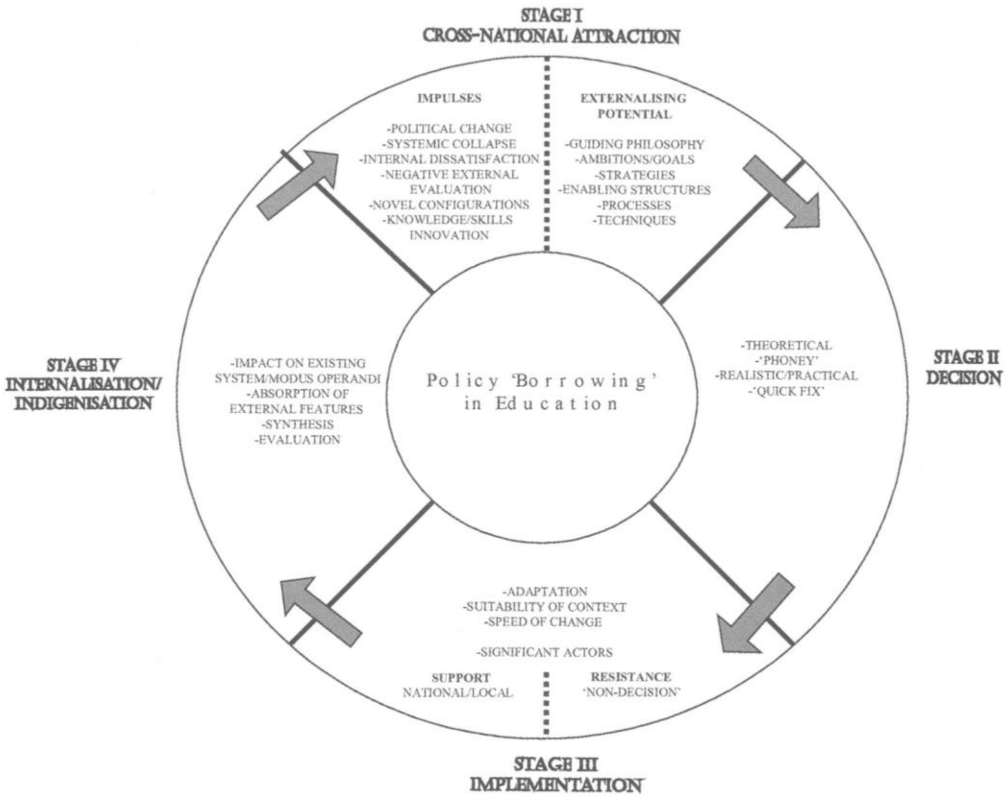


Figure 2.1 Stages of educational borrowing (Phillips and Ochs, 2003)

The fourth stage is internalization. There are four elements involved: the impact on the current system, the extent to which the borrowed educational method can be adopted, re-contextualization, and finally, reflection and evaluation of the borrowed practice. The incompatibility between the borrowed practice and the local conditions of the receiving country may result in different degrees of adoption and the need to re-contextualize the practice. This is in line with Noah (1986, p.161-162) who said, "The authentic use of comparative study resides not in wholesale appropriation and propagation of foreign practices but in careful analysis of the conditions under which certain foreign practices deliver desirable results, followed by consideration of ways to adapt those practices to conditions found at home".

In research involving issues of globalisation in mathematics education, Atweh and Clarkson (2002) used the term 'globalisation' to discuss this context of transfer, and borrowed the concept of, 'globalisation from above and below', as discussed by Falk (1993, cited in Taylor, Rizvi, Lingard and Henry 1997). Globalisation from above was defined as, "the collaboration between leading states and the main agents of capital formation. This type of globalisation disseminates a consumerist ethos and draws into its domain transnational business and political elites" (Falk, 1993, cited in Taylor et al., 1997, p.75). On the other hand, globalisation from below "consists of an array of transnational social forces animated by environmental concerns, human rights, hostility to patriarchy and a vision of human community based on the unity of diverse cultures seeking an end to poverty, opression, humiliation and collective violence" (Falk 1993, cited in Taylor et al., 1997, p. 75). Atweh and Clarkson (2002) argued that globalisation from above is often associated with *adoption*, copying, or importation of a foreign practice that may include some international aid projects. They continue that globalisation from below is often associated with *adaptation*, in which a certain educational concept is translated differently depending on local traditions and interpretations (Atweh and Clarkson, 2002). For the latter, Atweh and Clarkson (2002) cited ethnomathematics as an example. They also noted that variations in interpretation in adaptation are not specific to a particular culture.

In relation to the present study, while one may see the transfer of RME to other contexts as a copying or adoption practice, some scholars may find the term 'adoption' to be inappropriate. These scholars may think that it is actually an example of globalisation from below, and therefore is an adaptation. For instance, Marpaung (personal communication) argued that the PMRI movement was initiated by a small-scale, bottom-up approach, rather than by a large-scale, top-down approach. In practice, while the PMRI teams had adopted most features of the Dutch realistic textbook when developing the local RME-based curriculum materials, or when introducing the tenets of RME into teacher development programs, they ensured that they considered Indonesian circumtances, nature and culture. In this sense, it was not a wholesale adoption of RME as some adaptation had been made.

Throughout its history (see section 3.1) the PMRI movement has actually followed the stages described by Phillips and Ochs (2003). In the first ten years of implementation, PMRI has passed the initiation, pilot and appropriation phases. Since 2010, the movement has entered its institutionalization phase (Hadi, 2012). In light of the above complexities and debates about the transference of educational practice, this study is sensitive to both adoption and adaption of RME. The present study focuses on identifying the degree of adoption of RME in Indonesia, and the adaptations that have been made by local educators and policy makers. This unified approach was selected to understand the extent to which RME ideas can be accepted and integrated into various aspects of mathematics education in Indonesia, as well as identify those aspects that have changed through the transfer process. To give a foundation of the RME features, the sections that follow discuss the key principles of RME, and the tenets that characterize it.

2.2 Realistic Mathematics Education (RME)

2.2.1 History and Development of RME

According to the literature, (e.g. Treffers 1991, 1993; van den-Huevel-Panhuizen and Wijers, 2005), the history of RME can be traced back to 1968 when the ‘Wiskobas’ (Mathematics in Elementary school) project was initiated. This was followed by the establishment of IOWO Institute in 1971, (later known as the Freudenthal Institute). During that period, this movement stimulated the reform of mathematics education in the Netherlands. Dutch educators decided the ‘Realistic’ approach was a superior alternative to the prevalent mechanistic approach (Treffers, 1987, 1991).

Gravemeijer (1994) described that the today’s Realistic approach is greatly influenced by three prior approaches. Firstly, level theory developed by van Hiele (1973, cited in Gravemeijer, 1994), secondly, Freudenthal’s idea of mathematics as human activity, and thirdly progressive mathematization as depicted by Treffers (1987). Van Hiele (1973) distinguishes between three levels of thought in mathematics education: (1) the lower level, associated closely with concrete situations; (2) the second level, which is developing mathematical relationships; and, (3) the third level, whereby a consistency of thought has been achieved and learners are ready for abstract mathematics. Here, learning should begin with concrete situations and learners’ tacit informal knowledge, and then gradually allow students to build their own mathematical knowledge that evolves through the learning process. In order to start at the first level – the one that deals with phenomena that are familiar to the learners – Freudenthal argues *didactical phenomenology;* that learning should start from a meaningful contextual problem. Within the framework of *didactical phenomenology*, teachers are expected to provide relevant and real-life examples to promote learning (Freudenthal, 1983, 1991). Accordingly, the aim of a phenomenological activity is therefore, “to find problem-situations from which situation specific approaches can be generalized, and to find situations that can evoke paradigmatic solution-procedures as the basis for vertical mathematization” (Gravemeijer and Terwel, 2000, p.788).

In relation to the mathematization process described by Treffers (1987), it can be differentiated into horizontal and vertical mathematization. In the former, learning is shifted from the world of real-life into the world of mathematics, while the latter form emphasizes the process of reorganization within mathematics itself. Although the distinction between the two is useful, in fact they are very closely related one another.

Approach to mathematics education	**Mathematization**	
	Horizontal	**Vertical**
Realistic	+	+
Structuralistic	-	+
Empiricist	+	-
Mechanistic	-	-

Table 2.1. Types of mathematization in mathematics education (from Treffers, 1987, p.251)

In a more detailed description, Treffers (1987) used mathematization to differentiate between the mechanistic, structuralistic, empiricist, and realistic approaches to mathematics instruction. According to this scheme (as shown in table 2.1), the empiricist approach which emphasizes the discovery and investigation is only concerned with horizontal mathematization. While, in contrast, the structuralist approach is only involved with vertical mathematization, or advanced mathematics. On the other hand, the mechanistic approach was described in contrast to the realistic approach. It involves neither horizontal nor vertical mathematization; while the realistic approach concerned both concepts in this model.

2.2.2 The Underlying Philosophy

According to Gravemeijer and Terwel (2000), Freudenthal's idea of 'mathematics as human activity' is greatly influenced by *Didaktik* philosophy. In the Netherlands, Germany and other neighboring countries, the concept of *Didaktik* is rooted in a pedagogical theory based on the concept of *Geisteswissenschaftliche* (humanity) and the theories of *Bildung* (Gravemeijer and Terwel, 2000; Hopmann, 2007). In *Bildung*, whatever is done or learned is aimed to develop one's individuality, and "to unfold the capabilities of I" (Humbolt, 2000; Klafki, 2000). Adopting this idea, RME suggests that students should be given opportunities to construct their own learning through the exploration of their informal knowledge, and then progress to gain a deeper understanding of mathematics. Thus, a learning route or trajectory has to be developed which allows learners to find the intended mathematics for themselves (Freudenthal, 1973). The emphasis is on constructing a learning process that allows learners to also acquire personal knowledge. Therefore, in RME it is not necessarily for all learners to learn the same mathematics and reach the same level of development at the same time. Instead, they may have their own route to acquire their personal knowledge (van den Heuvel-Panhuizen and Wijers, 2005).

Moreover, Gravemeijer and Terwell (2000, p.791) described that according to Freudenthal, *Didaktik* should be concerned with processes. To illustrate this, they highlighted key similarities and differences between Freudenthal and Klafki's use of the term *Didaktik*. For example, rather than focus on the preparation of lessons, Freudenthal focused on the processes of learning, how the curriculum developer can provide a guideline for teachers, and how teachers can use this guideline for their classroom practices. On the other hand, Klafki was primarily concerned with the content of *Bildung*, whilst more or less not taking into account the teaching methods and processes.

2.2.3 The Characteristics of RME

In its implementation, RME can be characterized by the five tenets of RME (Gravemeijer, 1994), or the six principles of RME (van den Heuvel-Panhuizen and Wijers, 2005) which are described below:

2.2.3.1 The Five Tenets of RME

The five tenets of RME discussed here include phenomenological exploration, bridging by vertical instrument, students' own contribution and production, interactivity and intertwinement. Each is detailed below:

1. Phenomenological Exploration

This tenet is actually derived from the concept of didactical phenomenology as described earlier that emphasized the starting point of learning should be experientially real. According to van den Heuvel-Panhuizen (2000), the word 'real' or 'realistic' here comes from the Dutch word '*zich realiseren*', which means, 'to imagine' or 'make real in one's mind'. Thus, the 'real' here does not always mean the 'real' world, but rather the real constructed in students' heads. Teachers may provide learners with contextual situations that are imaginable, and so give them opportunities to explore their informal knowledge within the context. This process may include "exploration of the problem situation, visualization of patterns, and development of a model resulting in a mathematical concept" (Zulkardi, 2002, p.30). In this sense, the contextual problem should not only be viewed as the application of the concept, or as a tool to conclude the learning process, but instead as both the source for learning, and as the application of the concept. In short, the conceptual procedures and facts should not precede the contextual problems or real-life examples, this problematic ordering is often used in traditional approaches to teaching and learning mathematics. It is also noted that many so-called 'real' problems may be 'real' for textbook writers in their adult worlds, but may not be 'real' for students in their adolescent world.

Moreover, van den Heuvel-Panhuizen and Wijers (2005) suggested that the application problems given must be meaningful, informative, and suitable for mathematization. These characteristics are important to allow students to imagine the situation adequately and, thus can draw on their previous experiences and knowledge. In solving a realistic problem, students have to think about the situation, make some assumption and representation of the situation, and then find the general model for the situation. They might not be solvable if one does not place himself in the context or by simply applying a certain fixed procedure. However, these application problems should not be confused with the 'word problems' that often presented in a traditional mathematics classroom. van den Heuvel-Panhuizen (1996, p.20) said that word problems "are rather unappealing, dressed up problems in which the context is merely window dressing for the mathematics put there."

2. Bridging by vertical instruments

The second tenet is based on the idea that learning is a process moving from concreteness to abstraction. Treffers (1987) discussed 'bridging by vertical instruments' as one of the characters of RME approach, in which he emphasized the importance of self-developed models. Vertical instruments may include schemes, models, symbols, and other manipulatives, although models have a central position. A model here denotes a situation or mathematical representation developed by the students themselves. Treffers emphasized that the only function of the instruments is to bridge between mathematics grounded in reality and formal mathematics. Gravemeijer (1994) visualized this concept as in Figure 2.2. Thus, in RME, there four emergent models (Treffers, 1987; Gravemeijer, 1994):

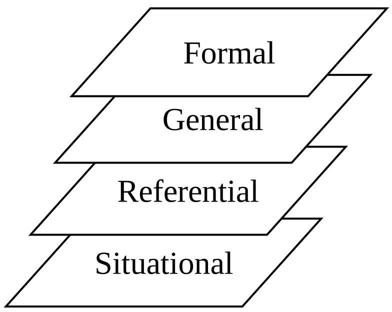


Figure 2.2 Emergent Modeling (from Gravemeijer, 1994)

a) Situational level: in this stage, students are expected to use their informal knowledge and intuitive strategies within the context of the problem.

b) Referential level: the referential level is often called the 'model-of' situational level. In this stage, students are expected to come up with a mathematical symbol or model referring to the real life situation of the given problem.

c) General level: in the general level, which is often called as 'model-for' level, students develop a model that could be used in different situations. Students are expected to identify patterns and relations in order for them to apply the strategies to different situations.

d) Formal level: in this phase, the students use their experience with the three previous levels to do reasoning. This is where they are finally ready to work with procedures, algorithms or notations.

In RME, this emerging model framework is believed to bridge the gap between informal and formal knowledge of mathematics. This framework is also often referred as the 'iceberg' phenomena in learning mathematics (see Figure 2.3).

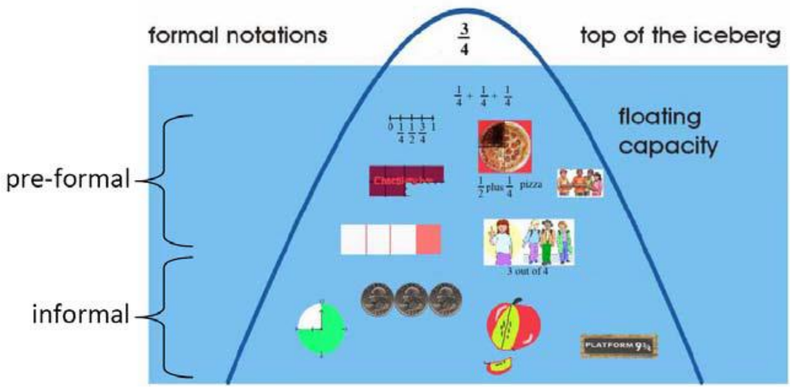


Figure 2.3 Iceberg model in learning Fractions (from Webb, van der Kooij and Geist, 2011, p.48)

As visualized in the above figure, the tip of the iceberg represents the formal mathematics, which needs a large foundation underneath (Webb, van der Kooij and Geist, 2011; Webb, Boswinkel and Dekker, 2008). In this sense, the foundation is built through developing students' understanding at the lower levels, then gradually through experiencing the application of mathematics in the situational level, and finally developing their informal understanding. Only after those strong foundations have been built are learners expected to be ready for a more symbolic and formal representation of mathematics. Using the above method, the situational level of 'fraction' might be presented through currency contexts such as relationship between cents, coins, and bank notes, sharing of foods, dividing circles into parts, or the loading time for downloading a file. The concrete materials to represent these contexts may include 'fake' money, circle shapes, apples, pizzas, or chocolate bars (to be divided), etc. While the schemes as the '*model of'* the situations and '*model for'* more general problems may include the bar model, number line or ratio tables. Finally, only after students have enough experiences with all the models are they expected to be ready with formal notation of fractions.

The four levels of transition described above are not fixed stages students have to go through. For example, students may progress through the situational to referential level, general or even formal level, but they can always fall back onto using the concrete materials (e.g. abacus, wooden blocks) or use the story or context in the situational level as reference whenever necessary.

3. Students' Own Contribution and Production

This tenet derives from the constructivist view of learning, which is also in line with the idea of mathematics as 'human activity' by Freudenthal (1968). According to this principle, mathematics is not a ready-made knowledge that can be directly transferred from the teacher to the students, instead learners are responsible to acquire and construct their own personal knowledge. In RME, learning is facilitated by the individual learner thought process and that of others. In doing so, teachers are expected to provide appropriate learning environments so learning is meaningful for students. While teachers have important role in guiding students' learning, they should not steer the process in a fixed way or demonstrate what students have to do or learn. Rather, the activities should give opportunity for students to come up with their own construction and production in solving mathematical problems.

In this vein, the contextual situation and the emergent modeling described above hold strong relationship to this principle. For instance, students may reach different levels of schematisation or strategy in solving a given problem in a particular lesson. Some students may already use a more efficient strategy, while some others still apply a more 'cumbersome' strategy to solve the same problem. In this approach, considering and discussing the kind of productions led students to a reflection of their own thought process as well as that of others. All these are expected to facilitate the construction of their mathematical knowledge.

4. Interactivity

The interactivity principle is based on the importance of discussion, communication, cooperation and negotiation in a constructive learning process. According to van Eerde, Hajer and Prenger (2008), interaction in RME classes is ideally organized across three activities: problematization, construction and reflection. They further distinguished between two forms of interaction: vertical interaction and horizontal interaction. Vertical interaction occurs when teachers lead the discussion with a group of students or with an individual student. Horizontal interaction occurs when student-student interaction takes place. In a more traditional classroom discourse, the teacher is expected to ask questions and then ask one student to answer, after which the teacher gives feedback. The interaction in RME is different. Teachers are expected to stimulate students to listen and learn from each other. From this perspective, an answer without an explanation is unacceptable. Differences of opinion is also encouraged. This may provide a more productive discussion so students can learn from each other and reflect upon their own answers. It is expected that through such activities, students will focus less on the teachers' judgment of a problem being right or wrong, and more on the actual learning process they are apart of. In RME, it is important that not only do students learn from the teacher, but that the teachers also learn to understand the students. According to this approach, teachers should facilitate students' learning in a way they can progress individually and contribute to the whole classroom learning, which is related to the reflection of students' thought processes described in the third tenet above.

5. Intertwining

The intertwinement principle argues teaching different mathematical strands simultaneously, rather than teaching the strands one by one. Consequently, contextual situations should involve the application of multiple mathematical concepts. Furthermore, the mathematical domain are not taught as distinct entities. According to this principle, an intertwining of mathematical domains, and the intertwining of activities is undertaken to give a broader understanding of the application of mathematics to the students.

2.2.3.2 The Six Principles of RME

Although the above five tenets are widely utilized to characterize RME, van den Heuvel-Panhuizen and Wijers (2005) has suggested the six principles of RME, rather than five tenets described above. The six principles include the activity principle, reality principle, level principle, intertwinement principle, interaction principle, and guidance principle. The principles were actually adopted from the five tenets of RME discussed earlier. For instance, the reality principle discusses about the importance of contextual or real-life problems both as starting point for learning mathematics and for the application of the mathematical concepts learnt; which mirrors the first tenet of RME. The level principle discusses the needs for using model and schemes to scaffold students' learning, similarly mirrored in the second tenet of RME. The interactivity and intertwinement principles are also similar to the fourth and fifth tenets of RME with the same name.

However, the framework makes explicit 'activity' and 'guidance' as two different, but related, principles. In the five tenets of RME, the two principles were characterized in the third tenet, students' own contribution and production. In the six principles of RME, the 'activity' principle stresses that learning should give opportunity for students to be active learners. According to the 'guidance' principle, teachers must anticipate that their guidance does not conflict with the activity principle. For instance, teachers should actively guide the learning process, "but not in a fixed way by demonstrating what the students have to learn" (van den Heuvel-Panhuizen and Wijers, 2005, p.290). Table 2.2 shows the mapping between the five tenets and the six principles of RME.

Five Tenets of RME (Gravemeijer, 1994)	**Six Principles of RME (Van den Heuvel-Panhuizen and Wijers, 2005)**
Phenomenological Exploration	Reality Principle
Bridging by Vertical Instruments	Level Principle
Students' Own Production and Contribution	Activity Principle
	Guidance Principle
Interactivity	Interactivity Principle
Intertwinement	Intertwinement Principle

Table 2.2 Mapping of the five tenets and the six principles of RME

In the present study, the RME principles refer to the six principles of RME, which was adopted from the five tenets of RME. Although Van den Heuvel-Panhuizen and Wijers (2005) pointed out that this is not a fixed list of principles, nonetheless, these principles reflect common values among RME educators. These principles and tenets have also been used as a guiding framework in different aspects of mathematics education such as curriculum development, textbook writing, teacher education and development, research, and in actual classroom teaching in the Netherlands (van den Heuvel-Panhuizen, 2000).

2.2.3.3 The Requirements to the Enactment of RME

Gravemeijer (2008) argues there are requirements to enacting problem-centered, interactive mathematics education in a RME classroom. This includes a planned reinvention route, the willingness of students to (re)invent and teacher competency to guide the reinvention process. One of the important aspects to the implementation of inquiry learning is firstly the availability of exemplary instructional activities that are consistent with RME. Teachers should be offered a general framework to design instructional theory onto on a day to day basis with the envisioned learning path. This learning path can be in the form of a set of instructional activities that is developed for a specific topic (such as ‘addition and subtraction up to 20’, ‘area’, ‘fractions’, and so forth).

The second aspect is the classroom culture that promotes reinvention or inquiry learning. Here Gravemeijer discussed about ‘socio norms’ and ‘socio-mathematical norms’ in the classroom, as depicted by Yackel and Cobb (1996). During learning, the teacher is expected to nurture norms that promote a classroom culture distinguished by explanation and justification of solutions, argumentation, indicating agreement and disagreement, and questioning alternatives in solutions. It is very often in such classrooms that a conflict in interpretation and solution become apparent (Gravemeijer and Cobb, 2006).

Yackel and Cobb (1996) also describe some forms of classroom climate that indicate the socio mathematical norms, which – unlike the socio norms that are content free – are related to mathematical progress. This includes, first, students asking each other questions that press for mathematical reasoning, justification, and understanding. Second, students explain their solutions using mathematical argumentation. Third, students reach a consensus using mathematical reasoning and proofs. Fourth, students compare their strategies looking for mathematically important similarities and differences. And fifth, students use mistakes as an opportunity to rethink their conceptions of mathematical ideas and examine contradictions. It is also important that this process allows learners to think about a more sophisticated solution, enabling them to control their own mathematical progress.

The third aspect is the teacher orchestrating the overall learning. This is the ability to see the variation of understanding and responses between individual students, to select topics that promote discussion, as well as to facilitate a productive whole class discussion.

2.3 Teachers' Attitudes towards RME and the Classroom Practice

2.3.1 Definition of Teacher's Attitudes towards RME

In research on teachers' attitudinal factor on teaching and learning mathematics, the terms beliefs, attitudes, and values were widely used. In relation to teachers' instructional practice, many researchers have suggested that beliefs and attitudes (Calderhead, 1996; Thompson, 1984, 1985; Pajares, 1992; Beswick, 2012) as well as values (Clarkson, FitzSimons and Seah, 1999; Clarkson, Seah, Bishop and FitzSimons, 2000) play a major role in teachers' instructional decision making and practice. While noting that differences in teacher's values are important, considering practical limitations, this study focused on investigating teacher's beliefs and attitudes, rather than values.

In research on beliefs and attitudes, some studies made distinction between the two, but they remain unclearly defined. For example, Fishbein (1967) limited the term attitude to the affective, while arguing that belief is more related to the cognitive components. In contrast, Speer (2005) highlighted that past studies often claim the evaluative and affective nature of beliefs (Thompson, 1992; Calderhead, 1996). In another study, Rokeach (1968, p.112) even described attitude as a consistent set of beliefs, as he defined it "a relatively enduring organization of beliefs around an object or situation predisposing one to respond in some preferential manner".

In another study, Gal, Ginsburg and Schau (1997) distinguished between beliefs and attitudes, but described both to be associated with cognitive and emotional aspects. They described attitudes as a representation of emotions and feelings that are relatively stable and have a smaller cognitive component than beliefs. On the other hand, beliefs are stable and resistant to change, with a larger cognitive and smaller emotional component. In their model, it also takes time to develop one's beliefs in which cultural context plays an important role in this development. A broad literature, however, suggests that teachers' beliefs towards teaching and learning mathematics could be changed through various means of supportive contexts (Szydlik, Szydlik and Benson, 2003; Bobis, Way, Anderson and Martin, 2016; Potari and Georgiadou–Kabouridis, 2009).

In relation to teachers' instructional practice, literature suggested that beliefs (instead of attitudes) greatly influence teachers' instructional decision and practice. For example, Pajares (1992, p.325) argued that beliefs are "instrumental in defining tasks and selecting the cognitive tools with which to interpret, plan, and make decisions regarding such tasks; hence, they play a critical role in defining behavior and organizing knowledge and information". In this sense, beliefs as the conception, ideology and worldviews upheld by the teachers greatly influence their instructional decision. These include decision about the content, routines, educational goals, and other socio-contextual elements of the classroom.

In the present study, as we aim to understand teacher interpretation and perception about RME, this distinction may not be very useful. In this study, the term beliefs and attitudes will be used interchangeably. Teachers' attitudes towards RME in this study refers to teachers's intentions on how they interpret and perceive RME as an instructional approach in the context of their teaching. This attitude may involve both a cognitive component and an emotional intensity of what they believe to be important or plausible in their situation.

2.3.2 Studies on Teacher Attitudes towards RME

Some studies conducted in the past have addressed the need to understand teachers' attitudes towards RME as an important factor contributing to succesful implementation. Most relevant to the present study, there are two major studies which investigated teachers' attitudes towards RME in the Netherlands. Wubbels, Korthagen and Broekman (1997) developed a questionnaire to measure teachers' attitudes towards RME as one of the means to evaluate a teacher preparatory program in Utrecht. They also utilized interviews to understand how the pre-service teachers perceived the realistic mathematics approach. The interviews were analyzed using thematic analysis encompassing four areas: inquiry-oriented approach, using mathematics in real life contexts, using mathematics as an activity of individual and groups, and the teachers' role in facilitating learning. However, Wubbels, Korthagen and Broekman (1997) did not discuss the development of the questionnaire or how the items measure teachers' attitudes towards each of the characteristics of RME.

Verbruggen, Frickel, van Hell and Boswinkel (2007) investigated Dutch primary school teachers' attitudes towards RME. They developed a questionnaire, namely the *Attitude Vragenlijst over Rekenen en Rekenonderwijs* (AVRR) and then administered it to a number of Dutch primary school teachers. The questionnaire was developed in light of the six RME principles (van den Heuvel-Panhuizen and Wijers, 2005) with each principle being represented by several questions. In interpreting the survey data, a factor analysis was conducted on the 48 items and the result showed that there were three factors extracted, instead of six (as suggested by the theory). The factors were labeled as Teacher Intention (*Leerkrachtintenties*), Lesson Structure (*Lessenstructuur*), and Student Opportunity (*Leerlingmogelijkheden*). In general, the Dutch teachers have high intentions towards the use of RME in the teaching and learning of mathematics and moderately high intentions in providing opportunities for students and flexible lesson structures. The researchers also followed up the results with classroom observation. This is discussed in the next section.

In light of the methods described above, the present study adopts the questionnaire developed by Verbruggen et al. (2007) to study teachers' attitudes towards RME. This questionnaire is regarded as relevant to the goals of this study for the following reasons. Not only were the items developed in relation to the six RME principles, but additionally both the AVRR and the present study target primary school teachers intending to use the RME approach. Furthermore, the reliability is satisfactory and the well-designed instrument allows this study to be utilized by other researchers for subsequent analysis. Most importantly, as the present research is focusing on studying the influence of culture towards the teachers' beliefs about RME, the results from survey in the present study using this instrument may be used in a comparison with the AVRR study. Using the same instrument opens up the possibility of a further analysis investigating if similar or different results occur in the Indonesian context. In addition to survey, to better understand teachers' attitudes towards RME, a classroom study and in-depth interview with some teachers was conducted. Specific details of the survey instrument are discussed in the methodology chapter.

2.3.3 Classroom Studies in RME Context

The present study identified two major prior studies aimed at understanding how teachers implement RME in classrooms. Firstly is the study by Verbruggen, et al. (2007), which was also discussed above. They conducted classroom observation with several teachers to follow-up the results of their large-scale survey. To study teachers' practice they analyzed the most interactive sections of the lesson. On average, 30-40 minutes of observation of each teacher was selected and analyzed. The lesson events fell within one of the five categories: relating to RME; attempted to enact RME but not very well articulated; opposite to RME; mathematics related (but neither as relating to RME, or attempt to enact RME nor opposite to RME principle); and non-mathematics related. In latter part of their analysis, Verbruggen, et al. (2007) decided to disregard the last two categories, as they were considered insignificant. This coding, unfortunately, does not address how to identify the six principles of RME, which were utilized during the development of the questionnaire, in the teachers' classroom practice.

The second study that specifically investigated teacher's RME-related classroom practice was conducted by De Ridder and Vanwalleghem (2010). In this case, a coding scheme based on the five tenets of RME was developed. This scheme allows one to examine how each tenet of RME has been enacted in the classroom. The scheme contains three main parts: the lesson structure, methods of interaction and the use of material. These three categories were further divided into sub-categories. Lesson structure is classified into review, repeat-automate, practicing, introduction, non-math related, and preparation sections. The method of interaction category includes the teacher-individual student interaction, teacher-whole class interaction, individual student-teacher interaction, student-student interaction, teacher teaching, students working individually and students working together. The use of material encompasses the use of contexts, use of schemes and models, making connection, and working systematically 'step by step'. The present study adapted the coding scheme developed by De Ridder and Vanwaleghem (2010) to analyze the teacher classroom practice. The coding scheme is relevant to this study as it was originally based off the five tenets of RME. This allows the researcher to observe how each of the characteristics of RME are enacted in the classroom. This study will apply the same coding scheme to the Indonesian and Dutch classrooms, aiming to interpret the similarities and differences found. A more detailed description of the coding will be discussed in chapter four.

2.4 Key Relevant Studies

2.4.1 'Mathematics in Context' and 'Making Sense of Mathematics' Studies

Upon its extensive implementation in the Netherlands, RME has inspired the developments of mathematics education in many countries, including the United States and the United Kingdom. Van den Heuvel-Panhuizen (2010, p.1) stated that RME "was, and still is, in great demand all over the world, even if only perhaps that it gives these countries good hope of being able to attain such high test scores as the Dutch".

In the United States, RME was adapted through the project of 'Mathematics in Context' (MiC) in 1991 by the collaboration between the University of Wisconsin-Madison and the Freudenthal Institute (Romberg, 2001; Meyer 1997). Through adaptation, RME ideas were incorporated into a set of curriculum materials developed in collaboration between the American and Dutch educators from the two institutions. The MiC curriculum was one of the curricula aimed at grade five to grade eight in the reformed mathematics education approach launched in the 1990s. The curriculum was considered relevant to the content, teaching, and assessment standards for school mathematics recommended by the NCTM. Accordingly, each unit of the MiC curriculum includes tasks and questions designed to support the vision of NCTM's *Professional Standards for Teaching Mathematics*. This includes, "encouraging students to engage in mathematical thinking and discourse, with some activities designed to extend students' strategies and ideas to new problem situations; exploring mathematical relationships, developing their own strategies for solving problems, using appropriate problem-solving tools, working together cooperatively, and value each other's strategies" (Romberg, 2001, p.2). These ideas seemed to fit the principles that characterize RME such as the activity principle, level principle, and interactivity principle.

In preparing the curriculum's implementation, the American researchers studied both teacher attitudes towards the curriculum, and the implementation in the pilot classroom. Romberg (1997) reported that while the implementation of the MiC curriculum motivated changes in American teachers towards teaching mathematics, the interactions in MiC classrooms is rather complex. This complexity is in terms of expecting teachers to change their instructional practice, and to address classroom management issues such as facilitating individual learning, effective small group work, and encouraging a variety of explorations of new concepts. Romberg (1997) also suggested that various interpretations of commitment, treatment fidelity, and teachers' needs for professional development are evident. In subsequent works, Romberg and Shafer reported that the American teachers involved in the MiC project had both positive and negative comments on its implementation (Romberg, 2001; Romberg and Shafer, 2004). Through interviews, teachers' logs and teachers' self-reported journals, they found that the differences in classroom instruction were evident for teachers with different attitudes. Teachers with positive attitudes towards the MiC curriculum were found to use a more progressive method of teaching than their counterparts that gave negative comments. Those who provided negative comments reported that they may face criticism, for instance that it is not the proper way to teach mathematics, which may come from colleagues, parents or the students themselves.

Inspired by the MiC project, some mathematics educators in Manchester, the United Kingdom, also decided to adapt RME in their curriculum in 2003. Dickinson and Hough (2012) described that one of the reasons RME was brought to the UK was the consistently strong performance of Dutch students in international comparisons such as the Programme for International Student Assessment (PISA) and the Trends in International Mathematics and Science Study (TIMSS).

Through borrowing, the British educators gained a set of MiC materials developed in the USA. As it received positive responses from British educators, the Manchester Metropolitan University decided to give funding for a pilot project on RME at Key Stage 3, using the US version of Mathematics in Context. In 2007, another project was started, namely, ‘Making Sense of Mathematics’, which covered the Key Stage 4 of UK schools. The project launch was collaboration between the Freudenthal Institute and Mathematics in Education and Industry (MEI) in the UK. This project resulted in ten booklets covering the Key Stage 4 Foundation tier curriculum. These booklets were built upon the experiences gained from the Key Stage 3 project, such as the need for materials from a British context, and an alignment with UK national tests. Nowadays, materials are also being produced for students in higher tiers, with projects following a similar pattern to the former.

During implementation, the British educators also studied the teachers’ beliefs and the classroom implementation of RME-based materials in some project shools. In one study, Hanley and Darby (2007) focused on how teachers’ engagement in the project affects their beliefs and attitude to mathematics teaching. Hanley and Darby (2007) interviewed all the teachers trained by the Manchester Metropolitan University (MMU) at the beginning and throughout the training. Their findings suggest the challenges of implementing RME in Greater Manchester may be different from that in the Netherlands, as well as from that in the USA. Furthermore, they argued that some customization and adaptation is necessary as teachers in different contexts and places may have different beliefs or preferences. In another study, Searle and Barmby (2012) reported that the teachers who participated in their project showed enthusiasm and strong beliefs for the RME philosophy. Through interviews and classroom observations, it was found that the teachers provided a variety of contextual problems, hands-on activities, and interaction methods in line with RME teaching philosophy.

Both the MiC and MMU research studies described above have described the complexity of RME adaptation to the USA and UK in which they did not fully replicate the success of RME enjoyed in the Netherlands. Some influential factors to these conditions can be identified such as factors at the classroom, school and education system level. Surprisingly, even in a rather Western culture such as the USA or UK, where one may assume that RME could be more sucessfully adapted, differences between RME as it is perceived by the Dutch teachers and their American and British counterparts existed. Thus, this limited RME implementation in their contexts. While culture may not be regarded by some as a critical aspect in RME adaptation in these countries, the fact that the Indonesian educational culture is significantly different from the Netherlands urges the necessity for the present study to focus on cultural factors. Furthermore, the above studies focused on how teachers perceived RME ideas and how they enacted the approach at the classroom. While these are also some of the aspects that this study examines, the researcher cannot simply rely on teacher logs or teacher's self-reporting as utilized in the MiC studies. This study may, on the other hand, consider the methodology utilized by Searle and Barmby (2012) to study the consistency between teachers' attitudes towards RME and their classroom practice. A more detailed description on this aspect is discussed in chapter four.

2.4.2 PMRI Studies

In the context of RME adaptation in Indonesia, a number of studies have been conducted since its first initiation in the late 1990s. These include studies focusing on RME-related teacher development programs, the classroom implementation of RME and the RME learning materials (Sembiring, Hadi and Dolk, 2008). Among the initiators of RME implementation in Indonesia, Hadi (2002) reported on the success of a series of teacher development models delivered to some teachers in Yogyakarta, Indonesia. He found that the piloted teacher development model had effectively facilitated the teachers' awareness on how to carry out RME in the classroom. Following the successful pilot, the development model used has been deployed nation-wide since 2001. De Haan, Meiliasari and Sari (2010) also reported similar results to Hadi (2002). They found that after joining the program, teachers became more familiar with RME and more aware and confident to use RME styled teaching in their classrooms.

In a more recent study, Ilma (2014) also reported that the participants demonstrated positive attitudes towards the development program, and both the test and observation results indicated that the teachers had a satisfactory understanding of RME. However, in this and similar studies, the focus has often been placed on promoting a particular approach, and on the success of the development program itself. The fact that the evaluation of teaching was based on peer-teaching practice in which the teachers conduct a demo and peer assessed, rather than a real classroom lesson, should also be taken into account when interpreting the results.

In another series of PMRI task forces, PMRI researchers conducted a number of studies around developing RME-based lessons and learning activities, utilizing a design research methodology (see Simon, 1995). They developed learning environments, programs, or learning activities to promote the use of an RME approach in classrooms (e.g. Fauzan, 2002; Zulkardi, 2002; Wijaya, 2008). These studies were mainly aimed at designing RME-based tasks localised to the Indonesian contexts rather than simply using the Dutch materials. Hadi (2012) argued that the differences between Indonesian and Dutch culture, nature, and contexts inspired this task force. It was also reported in most, if not all, of this type of study that the RME ideas can be reasonably well-enacted by the Indonesian teachers in the experiment classrooms.

However, one should interpret the results of such interventional studies carefully. Firstly, the teachers were not the decision makers of their instructional design. They often implemented the lessons that were prepared by the Dutch-educated designers or researchers. Thus, the lessons might not reflect how the teachers interpret and implement RME in their own teaching contexts. Secondly, it is common that the Dutch-educated researchers designed the lesson plan inspired by the Dutch curriculum guideline (i.e. TAL books), rather than Indonesian curriculum guideline. The lessons were experimental rather than following the regular programs. Thirdly, in this typical experimental study, the report might be biased. Such researchers set out to report the success, rather than failures, of the designed classroom activities. Finally, research in a single context may not allow ones to identify the strengths and weaknesses of the program.

In a study of teacher questioning in RME classrooms, Johar, Patahuddin and Widjaja (2017) addressed some of the above limitations by conducting a comparative case study between Indonesia and the Netherlands. They reported that Dutch students demonstrated a broader and more flexible repertoire of strategies in solving tasks, while the Indonesian students performed in a more uniform manner. Furthermore, the Dutch classroom was more open to students' engagement and exploration than the Indonesian case. Given the teachers in the two contexts intended to utilize the same questioning methods, the excerpts of classroom episodes in their study showed that the Indonesian teachers gave more guidance to their students, and at the same time students tended to wait for the teacher's instruction when solving a problem. While they argued that the structure of the curriculum in the two education systems could explain their findings, they did not discuss how this interpretation might be in conflict with previous study's findings that reported a consistency between the curriculum and RME ideas (Widodo, 2011; Dhoruri, 2010). Their research did not discuss factors other than the structure of the curriculum, such as the cultural differences between the two countries, which may further illuminate on the findings.

Considering what has been studied around Indonesian RME adaptation, the present research investigated the teachers' beliefs about RME, rather than simply studying their awareness of, or confidence in enacting the approach. At the classroom level, it is also important to note that the observations were non-participatory, and the researcher was not involved in the preparation of the lessons. The observations focused on how the teachers enacted each RME principle, and whether their teaching practice is consistent with their beliefs and the curriculum suggestions. Furthermore, while cultural factors have been acknowledged as the most important aspect of Indonesian RME adaptation, past studies have over emphasized finding the local Indonesian contextual problem, rather than focusing on the significance of culture (in terms of method of thinking, beliefs, values and norms rooted in Indonesian education) that may influence how RME ideas can be adopted in this country.

2.4.3 Past Studies on the Role of Culture in Educational Borrowing

Some studies on educational borrowing practice reported a complexity adopting a practice from where it was developed, to new contexts. Even when a certain educational theory or practice is imported to an education system that seems to be ready for implementation, some studies have reported inconsistencies caused by cultural differences. For instance, in a study of Cooperative Learning adaptation in Israel, Hertz-Lazarowitz and Zelniker (1995) found that Cooperative Learning is inherently culture-bound to its country of origin, the USA. This meant that the basic structure and techniques of Cooperative Learning were incompatible with Israeli education values. When an educational theory or practice is transferred to countries that differ strongly in culture, it can be anticipated those cultural differences will play an important role.

In a research on the teacher appraisal model implemented in Hong Kong, Walker and Dimmock (2000) identified incompatibilities between Hong Kong culture and the basic foundations of teacher appraisal as practiced in Western countries. Walker and Dimmock (2000) argued that the importance of openness and confidentiality in the appraisal model may not be compatible with the face saving culture in Hong Kong. Also in the Chinese context, using interviews, Liu and Feng (2015) found a cultural mismatch in the adoption of the Flipped Classroom method in Chinese classrooms. Such mismatch has raised dilemmas for teachers during implementation. The findings indicated that the Mainland Chinese (rooted in the Confucian Heritage Culture) understanding of knowledge production, transmission and the goal of education more generally differ from the Western understanding. These differences were the main source of teacher dilemmas. In the context of the Lesson Study research project, Kusanagi (2014) also found that culture played an important role in the implementation of Lesson Study in Indonesia, particularly within Javanese educational culture. He found that the bureaucratic culture of Javanese teachers, which is significantly different from in Japan, hindered the implementation.

While the above studies focused on highlighting the incompatibility between the underlying phiosophy of the Western approach and the cultural values in their adoptee context, Vu Thu Hang, et al. (2015) actually identified some alignment between them. They found that some values in CHC are actually in line with the idea of socio-constructivist learning practiced in Western countries. The cultural alignment between the two was then used as a basis for the development of a culturally appropriate pedagogy for their local context.

Moreover, some research in educational borrowing also utilizes comparative perspectives to obtain a more holistic picture of the adaptation process. Utilizing a framework by Trompenaars and Hampden-Turner (1997), Phuong-Mai et al. (2009) compared the CHC values, which underpin Vietnamese educational practices, with the underlying philosophy of the American educational approach, in terms of its compatibility with the Cooperative Learning theory. In another study, comprising a small-scale survey administered to Japanese and Filipino teachers, Ebaguin and Stephens (2014) demonstrated that the cultural differences between Filipino and Japanese teachers influenced their understanding of Lesson Study principles. They also utilized Hofstede's (2001) cultural dimension to interpret their findings. The open, collegial and democratic features of the Japanese lesson study approach could not be easily implemented in the Filipino context, where hierarchal relationships are more valued. Moreover, unlike the Japanese, Philippine culture is considered one of the most short-term oriented ones, and more tolerant towards deviance compared to the Japanese culture. Thus, Ebaguin and Stephens (2014) argued that the simple transference model of lesson study to the Filipino context would lead to difficulties.

From the above, we can see past studies suggest that cultural and contextual factors are an important influence on teachers' perspectives while borrowing a teaching practice. This process is complex, and worth to explore. While an investigation in a single context may be adequate, a comparative study will give a holistic picture of the cultural influence. The methodology may also either be theoretical analysis using a cultural framework, or an empirical study drawing on teachers' viewpoints of how they see the educational values embedded in practice.

2.5 Summary

The literature shows that RME adoption from one country to another is not a simple process, and that the local culture plays a significant role. While culture may not be regarded by some as a critical aspect in RME adaptation in Western countries, such as USA or UK, the fact that the Indonesian educational culture is significantly different from the Netherlands urges the necessity for the present study to focus on cultural factors. To understand the Indonesian educational culture, the next chapter will discuss the education system as well as the features of Javanese educational culture that underlies educational practice in this country.

Relevant past studies reviewed in this chapter have also informed the methodology and design of the present study. In the present study, RME can be characterized by the six principles of RME (van den Heuvel-Panhuizen and Wijers, 2005). This study adopts the questionnaire developed by Verbruggen et al. (2007), which was developed in light of the six RME principles, to study teachers' attitudes towards RME, and adapted the coding scheme developed by De Ridder and Vanwaleghem (2010) to analyze the teacher classroom practice. A more detailed discussion of the methodology will be covered in chapter four.

Chapter 3 –Research Background

This chapter presents background information about the educational contexts and approaches under examination to provide a foundation for the analysis. Section 3.1 depicts the history and development of PMRI in Indonesia. Section 3.2 explains Indonesian cultural values that are rooted in Javanese tradition, and section 3.3 describes the education system and mathematics curriculum implemented in Indonesia and the Netherlands.

3.1 The History and Development of PMRI in Indonesia

Owing to its colonial history, Indonesia borrowed its early mathematics curriculum from the Netherlands. Through its development, the Indonesian mathematics curriculum has been following the global trends in mathematics education. For example, in the late 1990s, some Indonesian mathematics educators again attempted to borrow the Dutch approach to mathematics education, namely the RME, owing to its successful implementation in the Netherlands. According to Hadi (2012), adopting RME is hoped to help Indonesian students perform as good as their Dutch counterparts in international comparative tests such as TIMSS and PISA. Besides, the RME promotion of meaningful learning and mathematical thinking were seen as opportunities to reform and improve the instructional practice in Indonesian classrooms.

According to the book *'A Decade of PMRI in Indonesia'* (Sembiring, Hogland and Dolk, 2010), the development of PMRI can be divided into several phases since its first incarnation. In the preparation stage, mathematics educators in Indonesia (with Prof. Robert Sembiring from Bandung Institute of Technology as the leader) introduced RME to the related stakeholders, including policy makers in the Ministry of National Education, rectors of some universities, teacher educators, and, most importantly, actual teachers through a program of small-scale socialization (Sembiring, 2010). With support from the Indonesian Higher Education Directorate (DIKTI), a number of scholars travelled to the Netherlands to study RME, in several cohorts. The first cohort was sent to study PhD programs under the World Bank Indonesian Secondary Teacher Development (PGSM) project, while the second and following cohorts were sent to pursue master programs in 2006, and during the years 2010 through 2014 (IMPOME program), in the Freudenthal Institute – Utrecht University under the generous scholarships funded by the NUFFIC (the Netherlands Organization for International Cooperation in Higher Education). These programs were conducted with the expectation that the Dutch-educated scholars would return home and serve as the agents to disseminate PMRI in their respective regions.

Several task forces have been aimed at the development of RME in Indonesia. These include task forces for teacher development programs, classroom research, and learning material development (Hadi, 2012). In 2001, twelve pilot schools across three cities were selected for classroom implementation of PMRI (Bandung, Yogyakarta, and Surabaya). During this pilot scheme, the local PMRI teams and Dutch consultants visited the schools and observed the lessons. These schools served as laboratorial sites for PMRI research projects. With an enthusiasm and aim to introduce PMRI to a wider section of the education system, the PMRI teams conducted workshops in many other cities across Indonesia, such as Jakarta, Palembang, and Banjarmasin. In these workshops, which were facilitated by the Dutch and Indonesian RME experts, mathematics educators were introduced to the RME tenets, and trained how to implement them in the classroom.

Today more than twenty-three teacher education colleges (LPTK) across Indonesia have participated in the dissemination of PMRI through teacher education programs, as well as in-service teacher development programs (Zulkardi and Ilma, 2010). As a result, there are nearly one thousand teachers with PMRI training or exposure. Most are primary school teachers, who all over the country have been joining the PMRI workshops, some of which have been served by the key PMRI teachers (Hadi, 2012). The schools where the key PMRI teachers are teaching are known as PMRI schools.

Concurently with the nation-wide dissemination of PMRI, the PMRI teams also conducted a task force to develop learning materials. The resulting textbooks are known as PMRI textbooks. According to Hadi (2012) the PMRI teams conducted a workshop for prospective authors. Subsequently they formed a team of authors capable of composing a complete set of PMRI textbooks for grades one to six (Amin, Julie, Munk, and Hoogland, 2010). During the development, the authors looked for inspiration from RME materials used in other countries, such as the Dutch realistic textbook series and the American MiC textbook series. Through developing the RME learning materials, the PMRI teams also identified, ‘Indonesian culture and nature’ as one of the most important elements of the learning materials. Thus, the focus of their research was on finding local Indonesian contexts to be used as starting points for learning a particular mathematical topic, rather than directly adopting from the Dutch context.

3.2 The Indonesian Educational Culture

Located in South East Asia, Indonesia is not influenced by Confucian Heritage Culture (CHC), the philosophy that underlies the educational practice of many countries in the region such as Singapore and Vietnam. Vickers and Fisher (1999, p.398) demonstrated that “Asian values has not, so far, fitted into the same spaces of identity construction in Indonesia as it has in some other ASEAN states; there has been no room for it”. Indonesian history, politics and culture are believed to be the dominant factors contributing to this condition. Instead, Indonesian educational culture is rooted in the Javanese tradition.

Given that more than forty percent of Indonesia's population is Javanese (Badan Pusat Statistik, 2015), it is not surprising to find the Javanese Philosophy has influenced many aspects of life in Indonesia. The fact that the founding fathers of this country were Javanese has also influenced the manifestation of Javanese traditions in the philosophical foundations of Indonesia; the *Pancasila* (the Five Principles). In Pancasila, there are five fundamental principles: "belief in one supreme God, a just and civilized humanity, unity of Indonesia, democracy wisely led by the wisdom of liberation among representatives, and social justice for all people of Indonesia".

To understand the Indonesian cultural values, therefore, this section will firstly review the Javanese tradition, and discusses its commonalities with, and differences from the CHC. Besides, as the analysis in the following chapters discusses the influence of culture in Indonesia and in the Netherlands towards the implementation of RME, this section also describes the Hofstede's cultural dimensions for the two countries, particularly those related to the beliefs and values of education.

3.2.1 The Javanese Educational Values

Throughout its history, Javanese civilisation had been influenced by interactions between the native animism *Kejawen* and the Hindu-Budhist culture that was built over centuries. It was not until the sixteenth century that Islam and European culture came to influence life in Java. This unique combination has marked the Javanese tradition and culture in a significant departure from the original indigineous cultures. The Javanese tradition can be characterized by some specific traits, such as politeness, courtesy, indirectness, emotional restraint, and conciousness to one's status in society. Below is described the features of Javanese culture as discussed in the literature.

Collectivism Roots

The Javanese cultures have a social orientation, or collectivism point of view (Koentjaraningrat, 1985; Geertz, 1991). Javanese society values the principles of conformity (*cocok*), harmony (*rukun*), peaceful (*tentrem*) and togetherness (*guyub*). From this viewpoint, a good individual should therefore put the common interest above their personal interest. Furthermore, it is important for all individual elements of society to develop a collective responsibility, as togetherness is very important.

Togetherness has two implications. On the one hand, togetherness is translated into the idea of *gotong royong* (teamwork), which suggests society members should help each other and to take part in solving a problem or in accomplishing a task. And on the other hand, togetherness is interpreted as being fair to all individuals in the group. A common Javanese saying expresses this as, '*titik podo kroso*', which means, equal share is important although everyone may only receive an insignificant part. In cases where parents or leaders would like to give an additional part to an individual, they are expected to not show this in public, else it may disrupt the group's harmony.

The Avoidance of Conflict and Indirect Communication

Javanese people also value social hierarchy, as reflected in the Javanese language. The language spoken to parents, older people, or someone with a higher position/status is different from the language spoken to those who are younger or the same age. This is done to be polite and show respect. In Javanese society, the concepts of harmony (*rukun*) and peace (*tentrem*), serve as the basic guidance for social interaction. A strong emphasis on *rukun* and *tentrem* has characterized the typical Javanese person as inexpressive, and trying to avoid social or personal conflict. In his observations on social interaction in Javanese communities, Clifford Geertz (1961, p. 147) found that "emotional stasis is of the highest worth and on the corresponding moral imperative to control one's impulses, to keep them out of awareness or at least unexpressed, so as not to set up reverberating emotional responses in others". This finding actually describes that expressing direct opposition is not socially acceptable in the community. Hence mutual avoidance often becomes the solution to a problem in order to avoid conflict and save face. In this regard, an open conflict should not occur in any situation, and nobody wants to be the intermediary of bad feedback. In the family, this expectation is often translated by Javanese parents in the parental teachings of self-control and the need to remain calm. This child-rearing practice, has results in Javanese children using less aggressive words in their communication than their Western counterparts (Farver et al., 1997).

Guru – Student Relationship

In Javanese society, the word 'teacher', or *Guru*, often refers to someone that is knowledgeable and is a source of learning. Therefore, it is regarded as impolite to question what they teach, to argue, or to challenge the guru's thoughts. In a larger society, *Guru* is also often considered as someone to be listened to and followed (*digugu dan ditiru*), as they are regarded as the role model for their students. In this aspect, there is a very well-known teaching philosophy among Indonesian teachers, which can be read in Javanese as '*lng Ngarso Sung Tulodo, lng Madya Mangun Karso, Tut Wuri Handayani'*. This has the meaning that teachers should be a role model first, and a companion and friendgiving encouragement and motivation second. Previous studies have shown that the first role of a teacher (as a role model) is dominant, while the other two aspects are often de-emphasized (Tirta-Sepoetro, 1999; Margono, 1996; Maulana, Opdenakker, Brok and Bosker, 2012).

This classic *Guru*-student relationship is believed to be the result of an emphasis on honoring one's elders and superiors. In order to maintain interactions and show respect, Javanese parents often teach their children to show obedience and respectful behaviors are constantly instilled in their daily life from an early age. In an educational setting, the teacher is equitable with parents, and therefore they deserve the same respect as parents. Interestingly, because of the high respect shown to teachers, it is not uncommon that young children listen to their teachers more than to their parents.

Expectation of Compliance

Javanese people also have a strong commitment to conformity. For example, in a Javanese saying, the word *manut* often refers to compliance, and to be considered strange or odd is perceived as *nyeleneh*; meaning crazy and lost common sense. In Javanese culture, one has to realize the need for, and respect, social norms. These norms help define good from bad, and right from wrong. This perception however, is not from only one’s own perspective, but rather from the lens of the larger collective system. To nurture this behavior from an early age, Javanese parents often compel in their children a sense of unpleasant consequences of *wedi* (afraid) or *isin* (shamming) if an action does not follow the prescribed rules. In doing so, parents may take away a previlage, such as toys or playtime, if they did not show the compliant behavior. Besides the emphasis on public conformity, Javanese people also expect their peers to show private acceptance (*nrima/trima*). A good Javanese person therefore has to display an attitude of grateful acceptance for his station in life and fate, without complaining.

Rote Learning

The Javanese tradition also emphasize *runtut*, which means to be proper and follow step by step striving for the best and the ultimate achievement. According to Mulder (1985, cited in Murtisari 2013), the ritualistic behavior shown by the Javanese is rooted in the spiritual values of Javanese tradition. This is the belief in a fixed formula called *ukum pinesthi* (law of destiny). With *ukum pinesthi*, life is seen as an inevitable thing each human being has to endure, shaped by a particular *titah* (destiny) that God has designed for that individual. There is a Javanese saying that, "life is a duty, to live what is already given to you (*urip kuwi mung sakderma nglakoni*)". This means that Javanese people believe that many things in life have been defined and given. Therefore, having been given a classic and well defined knowledge, it is not necessary for them to question its truth. Siegel (1986, p.148) noted that in the Indonesian educational setting "…whatever children learn turns out to be not their discovery but the property of 'tradition', that is something already formulated".

In this relation, Lewis (1997) noted that at home Indonesian students are often asked to memorize prayers, songs, or dogmatic sayings from an early age. Lewis (1997, p.17) observed that "… this practice is also reinforced at school, when students have to memorize the state ideology, Pancasila and the multiplication tables in Mathematics. Whilst reinforcing the strategy of memorization as a primary learning strategy, this process also reinforces the view that knowledge is an absolute truth." He also argued that this system of learning does not encourage variation in students' thinking, nor allow the questioning of what is taught. It is a common viewpoint that for each question there is one true acceptable answer, the teacher's answer.

3.2.2 Asian Values in Indonesian Education

There are some common features between the Javanese culture and the CHC, which can be identified from the literatureas being distinct from Western culture. As collectivist societies, both cultures emphasize togetherness over individual interests, as well as expecting individuals to publicly conform. As a result, Asian classes are distinguished in two ways. First is an emphasis on the product, rather than the process, of learning. Secondly is the use of a whole class learning approach, rather than individualized learning (Leung, 2001; Siegel, 1986; Tirta-Seputro, 1999; Chang et al., 2014).

While there are similarities, there are also some notable differences between Indonesian and CHC values. The Javanese believe that life is seen as an inevitable thing each human being has to endure with their particular destiny God has designed for that individual. Therefore, a good Javanese is expected to show grateful acceptance for his station in life and fate. On the other hand, Confucian societies, such as Chinese, have a long history of secularism. Consequently, it is not God, but individual efforts that determine one's own life.

The nature of destiny actually relates to another different feature between the two cultures as discussed in the literature. According to Haryono (1993) in his book '*Kultur Cina dan Jawa*' (The Chinese and Javanese Cultures), the most notable difference between Chinese and the Javanese cultural values lies in their attitude towards work. In CHC, there is also a high expectation from the East Asian teachers and parents for their students and children to succeed (Sollenberger, 1968). This can be seen from the East Asian teachers' way of teaching, as well as from child-rearing attitudes and practices which instill a high extrinsic motivation for learning (Ho and Kang, 1984). The majority of East Asian scholars' believe that an attitude of hardship is fundamental to one's success in learning, and is often translated into making a best effort even if it is beyond ones' limit to achieve their goals (Leung, 2001; Hess, Chang and McDevitt, 1987). In Javanese society, parents also teach their children to work hard and persist (*ulet*), and that they may work towards their goals slowly but surely (*alon-alon asal klakon*). Putting pressure on children is, however, undesirable, as it may only make the child frustated and depressed. In this sense, one should not force other people for something beyond their limit (*ojo ngoyo*). Javanese believe that while making one's best effort is important, ultimately it is God who decides the end result of these efforts. Everyone already has their own destiny and fate in life, and therefore, "life is a duty, to live what is already given to you (*urip kuwi mung sakderma* *nglakoni*)". On the other hand, in Confucian thought, one's own success or failure is depends on the hardwork and efforts of the individual.

However, the cultural differences between work attitudes should be interpreted carefully. For instance, using Leung's dichotomy (Leung, 2001) of 'studying hard' and 'pleasurable learning'. While the learning process in the CHC classrooms can be characterized as 'studying hard', the traditional learning process in Indonesian classrooms described in Chang etal. (2014) is not comparable to 'pleasurable learning' in the Western sense of the term. In Indonesia, joyful mathematics education often means to make learning more fun so children do not feel frightened or discouraged to learn difficult or demanding mathematics tasks. As Leung (2001, p.41) pointed out, "unfortunately, for some countries, pleasurable learning is equated with merely simplifying what is to be learned for students or introducing different sorts of activities in order to make the learning more fun. Students are enjoying the activities while learning mathematics rather than enjoying the activities in the learning of mathematics."

In terms of the practice of 'rote learning', while both CHC and Indonesian culture are characterized by rote learning (rather than meaningful learning as in the Western culture), the literature shows that Indonesian and CHC have different purposes for rote learning. Leung (2001, p.40-41) explained that "the East Asians think that memorization is not only a legitimate way of learning, but also the process of learning inevitably involves committing to memory things that are not totally understood. Learning is an interactive process of repeated practice, memorizing and understanding." On the other hand, Lewis (1997) described that in Indonesia, while memorizing activities is reinforced from early age, there is often no real purpose. When parents or teachers ask children to memorize prayers, songs, or dogmatic sayings, Lewis (1997, p.17) argued that the memorization might be aimed more at "… perhaps, accept to reinforce their identity as Indonesian, as Muslim or Catholic, or to 'show off' to/for their parents".

Finally, there is a subtle difference in the image of the teacher between Indonesian and the East Asian tradition. While teachers in both societies are seen as a source of knowledge and are role models expected to be a learned figure in terms of attitude and behavior, in Indonesia (particularly at primary education), teachers are generalists, and there is little expectation that they should be solidly competent in the subject matter, such as mathematics. It is often the case that pedagogical skills to deliver the content is more important than the competencies of the content. In contrast, in East Asian countries, teachers are regarded as experts or as a scholar in their field (Leung, 2001).

3.2.3 Hofstede's Cultural Dimensions for Indonesia and the Netherlands

The Hofstede's six cultural dimensions for Indonesia and the Netherlands are summarized in figure 3.1 (constructed from data in Hofstede, Hofstede and Minkov, 2010). This includes power distance index, individualism, masculinity, uncertainty avoidance, long term orientation and indulgence aspects of culture (de Mooij, 2010).

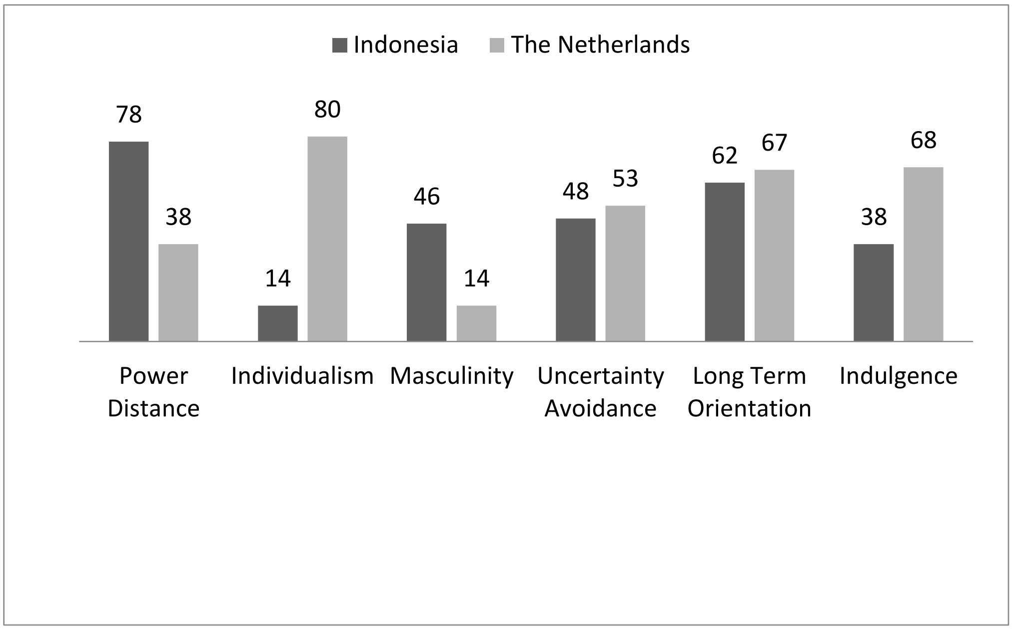


Figure 3.1 Hofstede’s cultural dimension for Indonesia and the Netherlands

Power Distance Index

Indonesia is characterized by a high power distance index. According to Hofstede, Hofstede and Minkov, (2010) a high power distance index indicates unequal rights between power holders and those without power. In these societies, power is more centralized and the leaders are more directive, and expect the obedience of their team subordinates. As an example, there is a classic guru-student relationship in Indonesian education where the guru holds the power over their students. Therefore in Indonesian education teachers and students have unequal rights, where students are expected to show compliance and submissive behaviour to their teachers. In contrast are countries with a low power distance index, such as the Netherlands, where people value equal rights in the society. According to de Mooij (2010), the hierarchy in this society is relieved for convenient purposes, and power is decentralized. Consequently, when decision making, it is important for leaders to involve and consult their subordinates. Hence their communication is direct and participative.

Individualism

Indonesia with low individualism rating is a collectivist society, while the Netherlands with high rating is individualist. As described above, in Indonesia there is a high preference for a strongly defined social framework. Individuals are expected to be free from self-interest and to conform to the ideals of the groups to which they belong. Here, the personal interest of *I* is limited, and togetherness is very important. In contrast, in the Netherlands, people's self-image is defined in terms of 'I'. In this society, whatever is done or learned is aimed to develop someone's individuality, to unfold the capabilities of 'I'.

Masculinity

While Indonesia is less masculine than other East Asian countries, it still has a higher masculinity rating than the Netherlands. A high masculinity rating indicates that society is driven more by competition and achievement. On the other hand, a low score indicates that the society values the quality of life higher than achievement. The subtle difference between the two is whether people see success as being the best in their field, or by doing what they like to do. In this regard, Indonesian people still value the 'prestige' (*gengsi*) that is often seen from outward apperance. In the Netherlands, however, the dominant value is not achievement or success, but rather the quality of life as the sign of success.

Uncertainty Avoidance

Indonesia scores slightly lower than the Netherlands in this dimension. In Indonesia, this dimension is mainly related to the concept of harmony (*rukun*) in the society in which the society members tend to avoid uncertainty caused by a conflict or direct confrontation. On the other hand, in the Netherlands, this dimension is related to the needs of punctuality and precision in all aspects of life. Dutch people value security as it is regarded as a fundamental aspect in individual motivation.

Long Term Orientation

Both Indonesia and the Netherlands score high in this dimension, which means that they have a pragmatic orientation. According to de Mooij (2010), a long term orientation shows an ability to easily adapt traditions to changed conditions, and a perseverance in achieving results.

Indulgence

In relation to the indulgence aspect in their cultures, Indonesia and the Netherlands have a large gap, as indicated from the scores in this dimension. With a high score in this dimension, the Netherlands is an indulgent society. They value the importance of leisure time and enjoyment in life. As a restrained society, Indonesian people have the perception that their actions are restrained by social norms, and therefore they often feel hesitatant to be indulgent. However, according to Geertz (1961), Javanese parents are very indulgent to young children, as they are regarded as *durung ngerti* (not yet able to understand). Javanese children are also heavily protected from danger and frustation, as children are regarded as a source of family warmth and happiness that can bring peace to parents' heart.

From the above, it can be seen that Indonesia and the Netherlands share some common features in terms of culture (i.e. long term orientation, indulgence towards children). However, many aspects of the two cultures were found to be significantly different. Indonesian culture can be characterized by a power distance index, but a low rating in individualism, while the Dutch have a low power distance index, but a high individualism rating. Besides, Indonesia also scored higher in the masculinity dimension than the Dutch. In interpreting the results and findings presented in the following chapters, the present study uses the descriptions presented in this chapter, particularly when looking for explanations from a cultural perspective.

3.3 The Education System and Mathematics Curriculum in Indonesia and the Netherlands

3.3.1 Indonesia

The Indonesian education system consists of six years of primary school, followed by three years junior high school, and three years senior high school. The basic education is conducted in the first nine compulsory school years for children age seven to twelve years in primary grades, and thirteen to fifteen years for students in junior secondary school. At the end of each school year, there is a standardized test designed and administered by the provincial education authorities. At the end of each school level, the test is administered by central government under the BSNP, or the National Education Standard Authority. The results of this high-stakes test (known as National Examination or *Ujian Nasional*), together with students' achievement in their respective school, is used as one of the decisive criteria required to graduate from school.

The education system in Indonesia employs a centralized curriculum in which the National Curriculum and Textbook Center (*Puskurbuk*) develops the curriculum guides and is in charge of textbook development. Currently, there are two versions of curriculum being implemented in Indonesian schools. The 2006 curriculum is being implemented in a majority of schools, with some selected schools (less than 5%) now piloting a new curriculum initiative to improve the 2006 version, known as the 2013 curriculum (*Dapodik DKI*, 2015). The 2013 curriculum was actually being implemented during the 2013 – 2014 academic year in many schools across the country, but in late December 2014, the Ministry of Education decided to defer its implementation until further notice and instructed schools to continue utilizing the 2006 curriculum. This decision was made following a large protest from education communities and teachers all over the country who were not ready to implement the 2013 integrated-thematic curriculum. Apart from the logistics and facilities issues, the teachers' competence to enact the integrated approach was questioned, as they had been immersed in the content-based approach for many years (Oebaidillah, 2016).

In Indonesia, textbook development for the 2006 curriculum is under the auspicious of the National Textbook Center (*Pusbuk, now is Puskurbuk*). The government purchases the copyright of the book from the publisher, or directly from the writer, when it meets the standards determined by the Center and BSNP. These books are known as *Buku Sekolah Elektronik* (BSE) textbooks. Schools can then choose one of the BSE textbooks available on the market. In fact, the organization and contents of the textbook series do not differ substantially from one another. In the PMRI schools, the teachers are also equipped with PMRI textbooks, developed and published by the PMRI teams.

3.3.2 The Netherlands

In the Dutch education system, primary school includes kindergarten one and two, and grades one through six. Thus, there are *groep* one to eight at primary level. Here, *groep* three in Dutch primary school is comparable to grade one in the international system. However, it is common to have combination classrooms in Dutch primary schools. For instance, there is a combination class of *groep* three and four (grade one and two). The students in this type of classroom have to learn more independently, although there are some sessions where they learn together as a whole group. After finishing their primary education, students continue their education at one of three different types of secondary education based upon their academic abilities (Nuffic, 2015): prevocational education (VMBO); general secondary education (HAVO); and general secondary education preparing students for university (VWO).

Unlike Indonesian education which employs a centralized system in curriculum development, there is no centralized decision making in the Dutch school curriculum. Thus, schools are given freedom to develop their own mathematics curriculum and freedom to choose the textbooks to be used. Despite this freedom, all schools follow roughly the same mathematics curriculum. The individual choices made by the teachers themselves, the mathematics textbook series, and the core goals (*kerndoelen*), are among the factors that influence what is taught in primary mathematics education in the Netherlands (van den Heuvel-Panhuizen and Wijers, 2005). The core goals, the standards which describe the content to be taught nationally, is the only document that is approved and published by the Ministry of Education. The most influential determinant of curriculum composition are the textbooks, as they guide the teachers' everyday decisions about what to teach. As for the textbooks, van Zanten and van den Heuvel-Panhuizen (2015) mentioned that schools can choose from among the textbooks available on the market. Of these textbooks, several reflect RME approach with, *Pluspunt, De Wereld in Getallen* and *Rekenrijk* as the most used textbooks. Thus, the schools that intend to use RME can be identified from the textbooks they use.

3.4 Summary

The information in this chapter forms the foundation for the analysis and discussion in the following chapters, particularly on how culture influences the RME adaptation in Indonesia. Furthermore, it also informs the present study's methodology, such as the data to be studied (curriculum documents and textbooks) and the targeted sample (the schools that intended to use PMRI and

RME in the respective contexts). The methodology will be discussed in the next chapter.

Chapter 4- Methodology

This chapter discusses the rationale of methodology and details the different phases of data collection and analysis. This forms the base to answer the research questions.

4.1 A Framework for this Study

In the present study, the six principles of RME (van den Heuvel-Panhuizen and Wijers, 2005) will be utilized as the guiding principle in examining the consistency between RME and various aspects of mathematics education in Indonesia. To explain the consistency and the inconsistency between RME and the implementation of RME in Indonesia, this study utilized a framework by Bishop (1988). The factors at cultural, societal, institutional and classroom levels will be explored. Furthermore, as comparative perspective allows one to have a more thorough perspective on the implementation of a borrowed practice, this study compares similar aspects in the Netherlands as a point of reference. This study anticipates that the differences in terms of educational culture and systems in the Netherlands and Indonesia might shape how RME is implemented in each respective context. This conception is shown in figure 4.1.

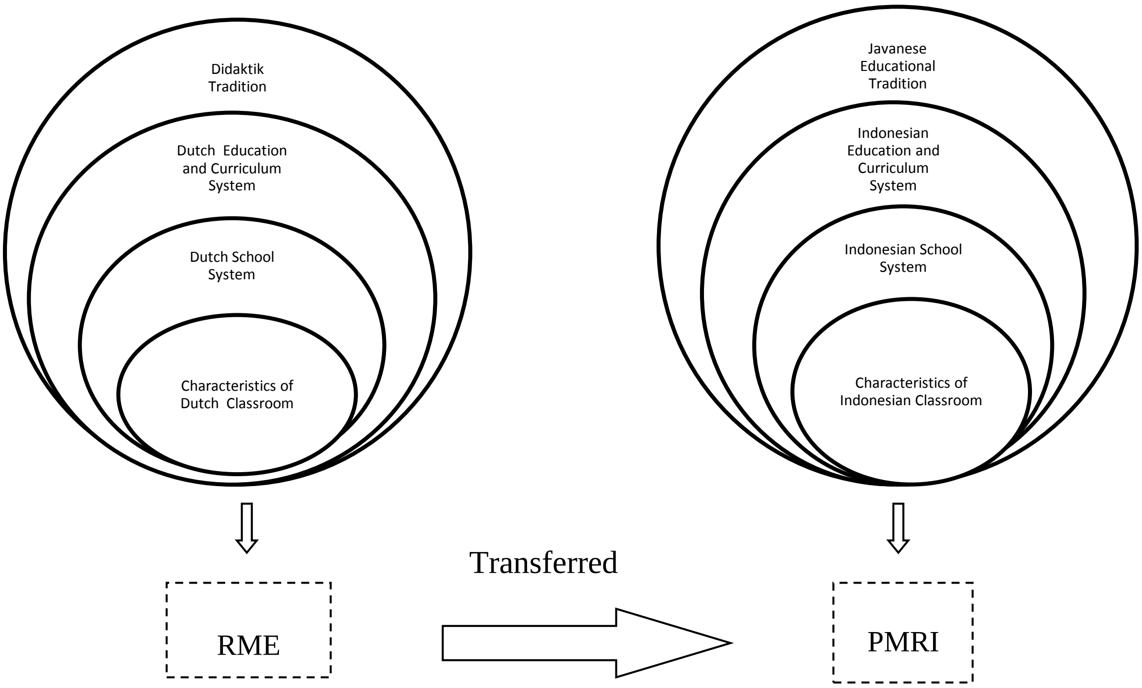


Figure 4.1 A framework for this study

As discussed in earlier chapters, another research focus of this study is to explore the influencing factors of the teachers' enactment of RME at classroom level. Indeed, a broad research of literatures has actually shown that teaching mathematics is inherently a cultural activity (Stiegler and Hiebert, 1999), and is affected by teachers' pedagogical beliefs that are often rooted in the socio-cultural context of their teaching (Ernest, 1989; Leung, 1992). Other studies have suggested that the curriculum and textbook (at the intended level) are the most influential factors to the teacher's instructional decision (Howson, 1995; Lui and Leung, 2013). The curriculum, which often represents national goals of a nations, is often regarded as the primary resources for teachers in determining what and how mathematics should be taught. Leung (1992) suggested a framework shown in figure 4.2 to study the relationship between curriculum, teacher beliefs and their instructional practice within a specific cultural context.

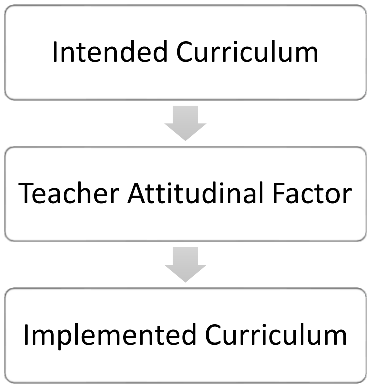


Figure 4.2 Relationships between the intended curriculum, teacher attitudinal factor and teacher actual practice (Leung, 1992)

According to the diagram, while the intended curriculum served as a guideline in the teaching and learning process and is regarded as the primary source for teachers in determining what and how mathematics should be taught, teacher attitudinal factor (teacher beliefs or attitudes) plays an important role in mediating this intention to be enacted at the actual practice. It is noted that although this model highlights crucial aspects in this study, it obscures other points. For example, the model includes teacher attitudinal factor as a critical component, but does not include school context, teachers' background, students' age level, or class size, etc. In this study the background information is acknowledged during the collection and analysis of the data to allow discussion of how these variables may influence teachers' practice. In the present study, the above frameworks have been adopted to guide the data collection, data analysis, and interpretation in this study. The details of each stage of data collection and analysis are discussed in the following sections.

4.2 Mixed Methods Approach

Taylor et al. (1997) reviewed the variety of approaches utilized in educational policy research. They identified that policy researchers often utilized qualitative methods as these researchers aimed to find an answer to the complexities of policy development and implementation. Furthermore, Maguire and Ball (1994, cited in Taylor et al., 1997) distinguished three orientations to qualitative work in education research. First is the analysis of long-term policy trends utilizing life history or interview data collection. The second orientation identified is 'trajectory studies'. This approach involves a study of the actual policy document production, followed by a study of the policy implementation. Thirdly are case studies of implementation that focus on policy interpretation and engagement. Furthermore, Taylor et al. (1997) noted that quantitative methods, used either alone or in combination with qualitative methods, might contribute in important ways to an understanding of the relationships between variables shaping the policy implementation.

In this study, a mixed-methods approach is adopted. In a mixed-methods study, the researcher incorporates qualitative and quantitative data collection and analysis methods into a single study (Creswell and Clark, 2007). A broad research literature has explored the advantages of mixed methods research over single-method approached (Denzin, 1970; Rossman and Wilson, 1991; Johnson, Onwuegbuzie and Turner, 2007; Creswell and Clark, 2007). For example, Rossman and Wilson (1991) suggest that mixed-methods approaches are superior to single-method approaches, particularly in the research design or analysis stages, for the following reasons. Firstly, in a mixed-methods study, different methods are employed to check the consistency of findings from one method and another. Secondly, it allows one method to complement the apparent weakness of the other one. Thirdly, "the results generated by one method can shape subsequent instrumentation, sampling or analysis strategies of the other method" (Rosman and Wilson, 1991, p.3). In this sense, a mixed-methods approach allows a researcher to address a question and theoretical perspective at different levels.

In the literature, there are two popular models for a mixed-methods study design, namely the sequential explanatory and the sequential exploratory models (Creswell, 2003; Tashakkori and Teddlie, 2003). In particular, Tashakkori and Teddlie (2003, p.227) described the first model as follows:

> "The purpose of the sequential explanatory design is typically to use qualitative results to assist in explaining and interpreting the findings of a primarily quantitative study. It can be especially useful when unexpected results arise from a quantitative study. In this case, the qualitative data collection that follows can be used to examine these surprising results in more detail."

Although the quantitative study is often given priority in this mixed methods design, Tashakkori and Teddlie (2003) discuss that the qualitative data collection and analysis may be given the priority in an important variation of the design. In this case, the results of the quantitative study may be used to find the general characteristics of the participants, and this information can then be used to guide the design for a primarily qualitative study. This design can be reported in two distinct phases with a final discussion that brings the two sets of results together. For example, the researcher might administer an instrument to a sample of a population, analyze the data, and then conduct intensive interviews or observation with a few individuals from the sample. Whereas in the sequential exploratory model, the principle was basically similar to the sequential explanatory model, but the qualitative study precedes the quantitative study. In this model, a researcher may start with a qualitative setting consisting of an in-depth study with a few individuals, which is then followed by a large-scale, quantitative study. This is done to combine the findings and to determine whether the results from small-scale study matches with that of the large-scale study.

In the present study, the sequential explanatory design has been adopted. A quantitative questionnaire survey was administered in the first phase of this study to understand the attitudes towards teaching and learning mathematics uphold by the PMRI teachers in general. This is followed by a primarily qualitative study that includes classroom study and in-depth interviews with some selected teachers to better understand if, and how, the espoused beliefs stated in the questionnaire is reflected at the implementation level. The qualitative study also includes an analysis on curriculum documentation and textbooks. The rationale of this methodology will be discussed in more detail in the next section.

Finally, to enhance the validity and reliability of the current research, a triangulation strategy was employed. The triangulation of data is utilized through applying same method to different research objects and the application of different methods on the same object, to reduce bias and enhance the validity of the research (Denzin, 1970).

4.3 Data Collection Methods

This section discusses the data collection methods in this study. The data collected includes primary mathematics curriculum document and textbooks, questionnaire, video-taped lessons, and interviews.

4.3.1 Curriculum Documents and Textbooks

As discussed in section 3.3, the PMRI schools utilize both the BSE and PMRI textbooks. Therefore, in the present study, the exemplary curriculum materials studied include the current Indonesian primary mathematics curriculum document (KTSP), the BSE and PMRI textbooks. As a comparison, the core goals (*kerndoelen*) of primary mathematics curriculum in the Netherlands as well as the Realistic textbook *De Wereld in Getalen* (DWiG) were studied. DWiG is among the most used textbooks in the Dutch schools (van Zanten and van den Heuvel-Panhuizen, 2015). The aim of the textbook analysis is twofold. Firstly, it serves as a means to understand how the curriculum is being operationalized. Secondly, it aims to serve as a background for the analysis in the classroom observation. For the latter purpose, the textbooks studied were from grade one, as the teachers being observed are all teaching grade one too (*groep* 3 in Dutch schools). The selection of the teachers is further discussed in section 4.3.3.

This document analysis approach is unobtrusive and can provide an objective description of the curriculum documents contents (Berg, 2012; Bowen, 2009). On the other hand, as noted by many previous researchers, text documents often "leave much open to interpretation" (Bowen, 2009; Cohen and Ball, 1990). Therefore, to better understand the development of the curriculum and the textbooks in Indonesia, in relation to the adoption of RME, the document analysis was supplemented by an interview with the curriculum officials and textbook author.

4.3.2 Questionnaire

To study the teachers' attitudes towards RME, a set of questionnaire was administered to the PMRI teachers who had been trained in PMRI-related workshops and trainings in twelve big cities in Indonesia. Based on the current report from PMRI team (Hadi, 2012), RME has been disseminated to thousands of teachers all over the country in 15 provinces where PMRI local centers are located, with some of them served by the key teachers, also known as PMRI teachers. Many of these teachers reside in the 12 cities that were chosen as research sites, as these places are among those which applied for the PMRI pilot studies since its first initiation. This includes Jakarta, Bandung (West Java), Semarang (Central Java), Yogyakarta, Surabaya (East Java), Malang (East Java), Padang (West Sumatra), Palembang (South Sumatra), Banjarmasin (South Kalimantan/Borneo), Makassar (South Sulawesi/Celebes), Singaraja (Bali) and Kupang (Nusa Tenggara).

The survey method was chosen mainly owing to its practicality as it is seen as easier to administer, more manageable, and the format enables respondents to answer more questions in the same time it would take to answer fewer open-ended questions. However, surveys are often criticized for the following reasons: they often limit the range of participant responses; they do not allow the respondents to qualify the chosen response; and finally, the uniformity of ratings may be deceptive and implant a bias (Visser, Krosnick and Lavrakas, 2000). Thus, to overcome these limitations, a follow up classroom study, as well as in-depth interview with some teachers, was also conducted to obtain a richer description of the participant responses, and to understand teachers's viewpoints about RME as indicated in their questionnaire responses.

As identified in chapter two, there were questionnaires from previous studies developed to measure teachers' attitudes towards RME. In this study, the questionnaire developed by Verbruggen, et al. (2007) which investigated the primary school teachers' attitudes towards RME, was utilized. The initial version of this questionnaire consisted of 92 items and was developed based on the six principles of RME, with each principle represented by several items associated with them, as shown in table 4.1. The final version of the attitude questionnaire, however, only consisted of 48 items measured with a five-point Likert scale (1 = strongly disagree, 5 = strongly agree). The results of factor analysis on the 48 items showed that there are three factors extracted, rather than six (as suggested by the theory). They were labeled as Teacher Intention (*Leerkrachtintenties*), Lesson Structure (*Lessenstructuur*), and Student Opportunity (*Leerlingmogelijkheden*). The reliability of the questionnaire was satisfactory with $\alpha = 0.94$. The reliability for each factor is 0.90 (22 items), 0.83 (11 items) and 0.90 (15 items) respectively. Of these items, 20 items have negative valence and were mirrored accordingly.

Activity Principle (16 items)	Interactivity Principle (12 items)
• Prior knowledge • Determine the content of the lessons • Individual solution method • Asking questions*	• Students learn from each other • Explanation of answers • Interactive education
Realistic Principle (16 items)	**Intertwinement Principle (16 items)**
• Importance of explanation • Understanding • Relation between math and everyday situation • Context	• Importance of relationships of different mathematical strands • Importance of Self Reinvention • Multiple Learning Tools • Holistic
Level Principle (16 items)	**Guidance Principle (16 items)**
• Multiple solution methods • Flexibel calculation • Level of Thinking • Level Progression	• Stimulation • High standard • Making mistakes • Responsibility

* *The cluster is not included in the final version of the AVRR.*

Table 4.1 AVRR questionnaire on the six principles of RME (Frickel, 2006)

Sample items for each factor are presented below:

(1) Teacher Intention (*Leerkracht intenties*)

'I think it's important for my students to explore math problems';

'*I think the Realistic Mathematics Education is only appropriate for regular students*'.

(2) Lesson Structure (*Lessen structuur*)

'It is important for students to get correct answers in mathematics lessons';

'Ideally, the students should take over my solution method'.

(3) Student Opportunity (*Leerling mogelijkheden*)

'I think it is too much if students have to investigate the mathematics problems by themselves';

'I think my students can come up with their own solution strategies'.

The questionnaire is very relevant for the current study, as mentioned in chapter two. Not only were the items developed based on the six principles of RME, but also both the AVRR and the present study targeted the primary school teachers who intended to use the RME approach as the respondents. Besides, the reliability is satisfactory and a well-designed instrument allows this study to be utilized by other researchers in subsequent analysis. Most importantly, as the present research is focusing on studying the influence of culture towards the teachers' attitudinal factor, this instrument may allow us to investigate if it gives similar, or different, results in Indonesian contexts. In doing so, some comparison between the results of the survey conducted in the present study and the results in the AVRR study was conducted. This was mainly aimed to see if the two studies would extract the same, or different, factors given the data was gathered from teachers from two different cultural contexts.

This, however, brings the issue of the language used in the instruments. As the original language of the questionnaire is Dutch, and the respondents in this study do not speak Dutch, the questionnaire was first translated into *Bahasa*, before its use in the main study. The translation was conducted by two Indonesian professional translators with a degree in Dutch Literature. The full version of the questionnaire in its original language, in *Bahasa* Indonesia and in English can be seen in Appendix 1.

4.3.3 Video Study

To study how RME is being enacted in Indonesian classrooms and to understand how it differs from that of the Dutch classrooms, the present study observed classrooms in Jakarta and Utrecht. Classroom observations were chosen as a method for the following reasons. Teachers' classroom practice has actually been studied using various methods such as the teacher self-report, classroom observation, and video study (Porter 2002; Henningsen and Stein, 1997; Leung, 1995; Stiegler, Gonzales, Kawanaka, Knoll and Serrano, 1999; Hiebert et al., 2003; Clarke, Emanuelsson, Jablonka and Mok, 2006). Despite the diversity of methods, teacher's self-reports are often used by researchers. On the other hand, scholars have often mentioned that teachers' self-reports are considered inadequate in terms of methodology. For example, Porter (2002) discussed that teachers might report what they think to be appropriate (instead of reporting their own practices), or they may think that they have used a particular approach (while in fact they have not). Furthermore, they may also not be clear on the terminology used in the questionnaire. On the other hand, classroom observation is seen to be capable of capturing the actual, authentic instructional practices.

However, unrecorded classroom observation might have a subjectivity issue, and the researcher may overlook some important classroom incidents. With current technology, a video-study is recommended for conducted classroom observation. According to International Association for the Evaluation of Educational Achievement (IEA) studies (Stiegler et al., 1999; Hiebert et al., 2003, p.5), "video offers a promising alternative for studying teaching. …the method has significant advantages over other means of recording data for investigating teaching". In this sense, video studies enable the examination of complex processes, increases reliability, is amenable to secondary analysis and coding from multiple perspectives, provides referents to teachers' descriptions, and facilitates communication of the research results of the research. To analyze the lessons, a coding scheme was employed (see section 4.4). Multiple lessons (four consecutive lessons), instead of single lesson, for each teacher were recorded. In a single lesson observation, there is the issue that the teacher may perform for the camera and researcher, distorting the data and results. Through observing multiple lessons, the researcher can see what normally happens in a lesson. The classroom observations were supplemented with an interview with each teacher, conducted at the end of the lesson series.

The classroom observations took place in Jakarta, where the researcher resided and has been part of the PMRI local team, and in Utrecht, where the Freudenthal Institute is located. In Jakarta, ten PMRI teachers participated in the survey, of which four teachers taught grade one, two teachers taught grade two, and one teacher taught each of grade three, four, five, and six. In light of this combination, the researcher decided to observe the three grade one classrooms.

The PMRI schools in Jakarta were under the guidance of local PMRI teams from the State University of Jakarta. However, located in Jakarta, one of the schools participated in this study was under the guidance of the local PMRI teams in Sanata Dharma University, Yogyakarta (as most of teachers in this school are the alumni of the university). The teachers had been involved in the PMRI-related activities at the local and national level for more than ten years, and all are regarded as "*Guru Mitra"* or the key teachers. In Utrecht, the Freudenthal Institute, Utrecht University, recommended the three teachers to be observed. In the Netherlands, the schools that intended to use the RME approach can also be identified from the realistic textbook they use. In this study, two teachers used *Pluspunt* and one teacher used *De Wereld in Getallen*.

4.3.4 Interviews

As mentioned earlier, an interview with the respective curriculum developer and textbook writer was conducted to supplement the document analysis. An interview was also conducted with each observed teacher. In research on the teacher beliefs and practice of RME, Searle and Barmby (2012) suggested an interview should precede a classroom observation. They aimed to study teachers' stated beliefs through the interview and then see if this was consistent with their instructional practice. In the present study, teachers' stated beliefs were studied through the questionnaire, and the interviews with the observed teachers were conducted at the end of their lesson series. Thus, the aim of the teacher interview in this study was mainly to better understand the consistencies or inconsistencies between their stated beliefs and their actions or instructional decision. Therefore, the analysis of the teacher interview will not only rely on the teachers' response on the questionnaire, but is also based on some observed classroom incidents of the teacher. The interview schedule is a reflection of the characteristics of RME. Finally, it is worth to mention that for practicality issues, only one interview was conducted with each teacher.

4.4 Data Analysis Methods

4.4.1 Curriculum Document and Textbook Analysis

In this study, the documentary analysis primarily looked at how RME ideas can be reflected in the curriculum guideline, and how they are being translated in the textbooks. To analyse the curriculum document, the aims and goals of the curriculum, the curriculum expectation on the mathematical skills and attitudes and the mathematical contents were all examined.

This study employs a modified framework by van Zanten and van den Heuvel-Panhuizen (2015) for the analysis of the textbook. The framework has been utilized to analyze some RME and non-RME textbooks in the Netherlands. The unit of analysis is 'a task' that require an answer from the student. According to this framework, there are three major perspectives to be studied, namely, (1) the content, (2) performance expectation and (3) learning facilitator. As their study was focusing on the decimals topic in the upper primary grades, and the present study focused on the number and operation topic in grade one, some modifications were made, particularly of the content and performance expectations. In their framework, the content may include (a) bare decimal numbers, (b) measurement decimal numbers, or (c) monetary decimal numbers. The performance expectation may include (a) mental calculation, (b) estimation, (c) written calculation, or (d) calculation with a calculator. In terms of learning facilitators, this is rather universal to any content, so the analysis would see if the textbook promotes the use of contexts, models and schemes (number line, charts, table), and the use of own productions. A more detailed version of the modified framework is depicted in chapter five.

4.4.2 Interview with Curriculum Developer and Textbook Writer

From a preliminary document analysis (of the curriculum guideline and a document of curriculum policy study), the researcher developed some interview questions that were addressed to the curriculum officials. The interview schedule for use with the curriculum developer consisted of questions covering the following themes: (1) background of drawing up the curriculum; (2) theoretical references in the curriculum development; (3) RME ideas adopted in the curriculum; and, (4) support for schools and teachers to implement the curriculum. Whereas, for the textbook writer, the interview schedule encompasses the following themes: (1) the aim of textbook writing; (2) the source and reference used in textbook writing; (3) task selection and design; and, (4) familiarity with RME. The complete interview schedules can be found in Appendix 3 and 4. Therefore, the analysis will focus primarily on identifying how the curriculum officials and textbook writer responded to the questions of each theme.

4.4.3 Questionnaire

The completed questionnaire responses were analyzed statistically. An exploratory factor analysis was conducted in which the factors extracted from this factor analysis were compared to the RME principles suggested in the literature to give meaning to them. The descriptive statistics of the results will be presented, for overall score and for each factor. Some of the results will also be contrasted with the results of similar study conducted by Verbruggen et al. (2007).

4.4.4 Coding Scheme for Lesson Analysis

This study adapts a coding scheme developed by De Ridder and Vanwalleghem (2010) that was developed based on the five tenets of RME to analyse the lessons. In the original coding scheme, the percentage of lesson time was analysed in terms of all the categories. In this study, while the interactions methods and the lesson structure categories were analysed in terms of percentage of lesson time, but the lesson events related to RME (i.e. use of context, use of models and schemes, etc) were analysed in terms of occurences. A more detailed explanation of the coding scheme is presented below. In the current study, for the following categories, the percentage of lesson time was analyzed:

1) Lesson structure

Lesson structure has six sub-categories:

a) Review

Review refers to all activities during which the class discusses the previous lesson. It aims to reinforce, check or seek out knowledge that is already possessed by the students.

b) Introduction

Introduction refers to all activities involving the introduction of a new topic or content. The teacher presents and explores problems that have not been discussed previously. Activities may also include explaining the goals of learning the new content, giving examples and introducing tasks.

c) Practicing

This subcategory encompasses all activities that involve students applying and practicing the topic or material they have learned, or completing tasks that have been introduced.

d) Repeat/automate

It includes all activities that involve tasks that assume everyone has already acquired the curriculum, and/or mastering the subject matter in relation to a full understanding by everyone. The activity may include giving additional tasks after practicing, or repeating the tasks that have been previously practiced.

e) Non-math related

Non-math related refers to all activities that are not related to the lesson content (e.g. taking attendance, making announcements)

f) Preparation

Preparation refers to all activities during the start of lesson, or to prepare the students to get ready for learning (e.g. distributing worksheets, writing on the board)

2) Method of Interaction

Method of interaction has seven sub-categories:

a) Teacher-whole class interaction

Episodes that may fall in this sub-category include, the teacher talking to the whole class, asking a question to be answered by all students (choiring), and asking all students to perform a task together.

b) Teacher-individual student interaction

An episode that may fall in this sub-category include the teacher asking an individual student to give an answer to a question or to perform a task.

c) Student-student interaction

Episodes that may fall in this sub-category include the teacher giving an opportunity to a student to explain their ideas or strategies in solving a task to their peers, to react to others's answers, or to compare their strategies with others. The teacher may facilitate the interaction between students or prompt and pursue their responses.

d) Individual student-teacher interaction

An episode that may fall in this sub-category includes an individual student initiating a discussion or asking the teacher a question.

e) Teacher teaching

An episode that may fall in this sub-category includes chalk and talk or the teacher teaching the content without students' participation.

f) Students work individually

An episode that may fall in this sub-category includes students completing an independent task

g) Students work together

An episode that may fall in this sub-category includes students working together in pairs or in small groups.

For the following events, the occurrence will be observed:

(1) Use of context (realistic problems)

a. Teacher uses contextual problems as the starting point for introducing the topic.

b. Teacher uses contextual problems as the application of the introduced topic or content.

(2) Use of model and schemes

a. Teacher provides concrete models/ manipulatives

b. Teacher introduces some schemes, diagrams, or tables as a general model

(3) Use of bare number problem: Teacher gives some tasks or exercises without contextual problems.

(4) Making connections: Teacher integrates different mathematical concepts or makes a connection between mathematical contents orbetween mathematics and other subjects

(5) Working ‘step by step’:

a. Teacher requires students to follow fixed steps or instructions rigorously

b. Teacher introduces a standard method or procedure

According to the scheme, the five tenets of RME can be indicated through the results of the observations through the above categories as shown in table 4.2. From the table, it can be seen that the categories under lesson structure are not utilized as indicators of the five tenets of RME. However, according to the coding, the lesson structure may further explain the natures of the activity that occurred in the lessons. For example, in the case that a teacher quite frequently gives opportunities for students to work together, we may want to know whether the activities are involving reviewing, or exploring new content, or practicing, or repeating/automatizing.

Furthermore, as the coding scheme was developed based on the five tenets of RME and the questionnaire was developed based on the six principles of RME, this study may match some findings from the questionnaire to the classroom observations, and therefore study the consistency between teachers’ beliefs and practice, which will be discussed in chapter eight. This study will apply the same coding scheme to the lessons in Jakarta and Utrecht, and interprets the similarities and differences found. However, as the observation were conducted in two different contexts, the researcher made allowances for necessary adjustments in the pilot study, as well as in the main phase of this study.

Five Tenets of RME	Indicator
Phenomenological Exploration	Use of context/ realistic problems (compared to the use of bare number problem)
Bridging by Vertical Instrument	Use of model and schemes
Students' Own Contribution	Lesson activity: • individual student-teacher interaction; • student-student interaction; • students work together
Interactivity	Lesson activity: • teacher-individual student interaction, • teacher-whole class interaction, • individual student - teacher interaction, • student-student interaction, • students work together
Intertwinement	Making connection

Table 4.2 Indicators of the classroom coding on the five tenets of RME

4.4.5 Interview with Teachers

The aim of the interviews was to understand teachers' responses to the questionnaire as well as to understand their thoughts about some classroom incidents. The interview results helped the present study by explaining the consistencies and inconsistencies between teachers' stated beliefs and their practice. Therefore, the teacher interview utilized the questionnaire as well as some selected classroom incidents from the class observation as a base. The interview schedule is a reflection of the characteristics of RME and includes the following topic: (1) The use of the realistic approach; (2) The use of contextual problems; (3) The worked sample questions; (4) The uniform tasks; (5) The interaction between students; and, (6) Content-based approach. The analysis of the interview was aimed primarily at identifying how teachers responded to the questions within the themes.

4.4.6 Interpretation

With the findings on the implementation of RME in various aspects of mathematics education in Indonesia, this study is looking for an interpretation on how the findings can be explained, particularly from a cultural perspective. The discussion may start with a summary of the findings and evidence from the data sources. The findings were then related to the Javanese cultural features, as described in chapter three, to form explanations. Finally, alignment and divergences between the Javanese cultural tradition and RME were explored and characterized. Furthermore, as culture may not serve as the single factor to explain the phenomena, some possible explanations from other social dimensions of mathematics education, as suggested by Bishop (1988), are explored. This includes the social dimension of mathematics education at the pedagogical, institutional and societal level.

4.5 Pilot Study

In order to guarantee the validity of the research instruments in the main study, the researcher carried out a pilot study in Jakarta from mid-July to mid-August, 2015. The purposes of the pilot study were:

- to test whether the translation of questionnaire can be understood clearly and that it is not ambiguous
- to estimate the time needed to conduct the interview with the teachers

- to examine whether the teacher' interview schedule is adequate or needed to be revised
- to test whether the video camera can satisfactorily record the lessons
- to test whether the coding scheme to analyse the classroom practice is adequate

Owing to personal limitations, the pilot study was conducted mainly in Jakarta. Following are the findings from the pilot study.

4.5.1 Subjects

In the pilot study, five PMRI teachers were invited to fill in the questionnaire and, of those, two teachers were interviewed and observed. The profile of the teachers participated in the pilot study is shown in table 4.3. below:

Teacher	**Gender**	**Teaching Experience (Year)**	**Questionnaire**	**Interview**	**Classroom Observation**
T1	F	10	Y	N	N
T2	M	17	Y	Y	Y
T3	F	25	Y	N	N
T4	F	17	Y	Y	Y
T5	F	7	Y	N	N

Table 4.3 Profile of subjects in the pilot study

4.5.2 Pilot of the Instruments

Questionnaire

The teachers were asked to fill in the questionnaire that had been translated into *Bahasa* Indonesia. From the pilot study results, it can be estimated that it may take 15 to 25 minutes to do the questionnaire. In general, teachers found the wording of the questionnaire to be clear and unambiguous. However, some teachers suggested that for the survey in the main round, the 48 items of the questionnaire could be formatted to be a maximum of two pages to keep the teachers' interest while filling in the questionnaire, although it must be presented in readable font size. The information about the scale 1 -5 (1 = strongly disagree, 3 = neutral, 5 = strongly agree) should also be available on each page so participants do not need to look at the first page each time they need to refer to the scale information.

Teacher Interview

According to the results of pilot study, the two interviewed teachers addressed the interview questions quite well. However, in answering some questions related to aspects that were not present in their lesson, such as "why was student-student interaction absent in your classroom?" the teachers only gave short answer and did not explain any further. Therefore, the questions addressed in the main study should be more explicit and some sub-questions were added. The final version of the interview schedule is shown in appendix.

Observation Schedule

The videos were transcribed for coding. From the findings of the pilot study, an additional sub-categories during the 'practicing' session is included for the analysis in the main study. Given that teachers provided a significant amount of time for students to practice, the teachers showed different involvement or guidance behaviors during students' work. The analysis utilized a framework by Maulana, Opdenakker, Stroet and Bosker (2012), which also studied the lesson structure of Dutch and Indonesian lessons. The three behaviors observed include helping individual students or groups, helping the class rather than individual students, and no contact. During observation, the researcher also took notes to record the classroom conditions, the examples or task presented, seating arrangement, etc.

4.6 Summary

This chapter has provided the description of the design and methodology adopted in this thesis. In the chapters that follow, the analysis of the collected data is presented and the findings are discussed. The data includes the curriculum and textbooks, teachers' responses on the questionnaires, teachers' classroom practice as well as the interviews with the teachers, the curriculum developer and textbook writer. The details of the methodology of this study can be summarized in table 4.4.

Research Question	Data	Method
1. How RME principles are reflected in the Indonesian exemplary curriculum materials, and how does this differ from that in the Netherlands?	Curriculum document, textbook, interview with curriculum developer.	Document Analysis and Analysis of the Interview Scripts
2. What attitudes towards teaching and learning mathematics do the PMRI teachers uphold? How consistent are their attitudes with the RME principles? How are the attitudes different from that of the Dutch teachers?	Questionnaire	Verbruggen, et al. (2007)
3. How do the PMRI teachers implement the RME principles in their classrooms? How is the implementation different from that of the Dutch teachers?	Video-taped lessons	De Ridder and Vanwalleghem. (2010)
4. How are the PMRI teachers' classroom practices consistent with their attitudes to teaching mathematics?	Questionnaire result; lesson analysis; interview with teachers	Study the consistency between teacher attitudinal score and their practice
5. What factors can be accounted to the findings? How does culture influence the implementation of RME in	Interpretation	

Indonesia?		

Table 4.4 Summary of research questions and methodologies

It is noted that although the researcher examined the data for quite specific indicators as described above, the researcher was also open to unexpected findings that might also give insight into the processes under examination. For example, some findings related to the differences between the PMRI, BSE, and the Dutch Realistic textbooks presented in chapter 5 were not covered by the method of analysis in van Zanten and van den Heuvel-Panhuizen (2015), yet were apparent during the analysis process.

Chapter 5 – RME Reflected in the Curriculum

This chapter discusses the extent to which RME principles were reflected in the curriculum documents and textbooks in Indonesia and the Netherlands. Section 5.1 depicts the aims and contents of the Dutch and Indonesian primary mathematics curricula and discusses their consistency with RME ideas. Section 5.2 presents the interview result with the curriculum official in Jakarta. This interview aimed to supplement the information provided in the document. Section 5.3 discusses how RME ideas are reflected in the textbooks of the two contexts. Three textbooks including a Dutch 'realistic' textbook (*De Wereld in Getallen*) for grade one, or *groep* three in a Dutch school; a BSE textbook for grade one; and the PMRI textbook for grade one, are analyzed. Section 5.4 presents the interview results with the textbook writer to supplement the analysis in section 5.3.

5.1 RME Reflected in the Intended Curriculum

In its country of origin, RME has been utilized as a guideline in various areas of mathematics education, including curriculum development (van den Heuvel-Panhuizen and Wijers, 2005; van den Heuvel-Panhuizen, 2000). In Indonesia, RME theory has also been reviewed as among the theoretical references during the 2006 curriculum development (Pusat Kurikulum, 2007). Therefore, it can be anticipated that RME ideas will be reflected in the curriculum documents of both countries. To understand the consistencies between RME and the curricula in each respective context, this section will firstly discuss the aim and goals of, and the contents covered in, each curriculum. This is followed by a discussion on how they are consistent with the RME principles depicted in chapter two.

5.1.1 Aims of the Curriculum

In relation to the aim of mathematics education at the primary level, both Dutch and Indonesian curricula aim to equip students with a good knowledge of mathematics and its application in contextual situations as well as to develop students' way of thinking (intellectual development, creativity, and logical thinking). The curricula also suggests mathematics learning should be joyful for the students. Below is the description of the Dutch primary mathematics curriculum, as depicted in *Kerndoelen,* or the 'core goals', regarding this aim (SLO, 2004):

> "Primary education aims **to broadly educate children**. The education addresses their **emotional and intellectual development, the development of their creativity, and their acquisition of social, cultural and physical skills**" (p.1).

> "In the course of primary education, the children will gradually **acquire – in the context of situations that are meaningful to them – familiarity with numbers, measurements, forms, structures, and the relationships and calculations that apply to these**…When selecting and offering the subjects, the children's levels of knowledge and ability are kept in mind, as well as their other areas of development, their interests, and topicalities, so that children will **feel challenged to carry out mathematical activity and be able to do maths at their own level, with satisfaction and pleasure"** (p.4-5).

While that of the Indonesian is shown below (BSNP, 2006):

> "**Mathematics is a universal science** that underlies the development of modern technology, have **an important role in a variety of disciplines and promote the power of human thought**… **To create and develop the future technology, it is important to have a strong mathematical ability since early ages**. Mathematics subject should be taught to all students **since the primary years to equip them with the ability to think logically, analytically, systematically, critically and creatively**

> **as well as the ability to cooperate**. The competencies were important in order for them to acquire the ability to collect, manage, and utilize the information to survive in a keep changing world that is uncertain and competitive... in every opportunity, **mathematics learning should be initiated with an introduction of situational problems (contextual problems)**. By probing a contextual situation, it is expected that students will be **gradually guided to master the mathematical concepts**" (p. 416-417).

> "Curriculum is expected to be implemented by incorporating five principles of learning... Learn to build and find identity **through an active, creative and joyful learning process**" (p.10).

Despite the similarities, the curricula have different emphases. The Dutch curriculum stresses the importance of a meaningful and personalized mathematics learning style (to learn mathematics at one's own level) and to empower the learners's intelectual ability. The Indonesian currriculum aims to develop students' strong content mastery from an early age to form the foundation of their future mathematical development.

5.1.2 Skills and Attitudes

In terms of skills, the curricula in the two places are aimed at equiping students with the skills to understand mathematical concepts, as well as developing their communication and problem solving skills, as shown below:

The Dutch curriculum expectations in terms of skills (SLO, 2004):

- Using Formal Notation of Mathematics

  The curriculum expect students to develop their mathematical language in terms of mathematical terms, notations, and schematisation. "This mathematical language concerns arithmetical, mathematical and geometrical terms, formal and informal notations, schematic representations, tables and graphs, and exercises for the calculator" (p.4).

- Using of Technical Elements

As shown above, the curriculum also particularly expected students to be able to use a calculator as a tool that can help with technical computation. How and when the calculator is introduced to students, however, not very clear. Most likely, it may be introduced in the upper grades.

- Mathematical Literacy

The curriculum also specifies that not only do they aim to develop each student's mathematical language, but also his mathematical literacy. The sources of this literacy may come from problems encountered by students in their daily life, in the application of mathematics in other subjects (such as art or physics), or within mathematics itself (e.g. measurement problem). The curriculum states, "they will learn to use 'mathematical language' and gain 'mathematical literacy' and skills in calculus. The subjects according to which children develop their 'mathematical literacy' have different origins: everyday life, other development areas, and mathematics itself" (p.4).

- Communication

The Dutch curriculum emphasizes the needs to develop communication skills in which they aim to develop students' skills in giving an argument and providing a justification (to give and receive criticism). The curriculum states, "they learn to give and receive mathematical criticism with respect for another person's point of view. Explanations, formulations and notations, as well as the giving and receiving of criticism, are all part of a specifically mathematical method that will teach children to organize and motivate ways of thinking and to avoid mistakes, independently as well as together with others" (p.5).

- Problem Solving

  The curriculum also expect students to learn problem solving skills in which they are expected to be able to understand a given problem or task and think about how to solve them mathematically. The curriculum states, "they are able to ask mathematical questions and formulate and solve mathematical problems. During the arithmetic or maths lesson, the children learn to solve a problem in a mathematical way and explain to others the solution in mathematical language" (p.5).

The Indonesian curriculum expectations in terms of skills (BSNP, 2006):

- Understand Mathematical Concepts

  As aforementioned, the curriculum aims at equiping students with a strong foundation of mathematical knowledge. Therefore, it is important for students "to understand mathematical concepts and see the relationships between them" (p.417).

- Mathematical Reasoning

  Unlike the Dutch curriculum that uses the term "mathematical literacy", the Indonesian curriculum aims to equip students with the ability to use "mathematical reasoning". Students are expected to be able "to use the reasoning on the patterns and properties, do mathematical manipulation in making generalization, compile evidence, or explain ideas and mathematical statement" (p.417).

- Communication

Similar to that of the Dutch, the Indonesian curriculum also aims to develop students' communication ability. Students are expected to be able to, "communicate ideas using symbols, tables, diagrams, or other media to support evidence in problem solving" (p.417). Yet, it does not specify how the communication should be conducted, e.g. whether criticism or argumentation is encouraged.

- Problem Solving

In terms of problem solving, the curriculum also aims at develop students problem solving ability. This may include the ability to solve mathematical problems, which includes the ability to understand the mathematical problem, develop a mathematical model, solve the model, and interpret the result. The problems or tasks provided in the classroom, therefore, should be varied. This can be in the form of closed and open questions with a single solution, or open questions with multiple solutions. However, as discussed further in a later section, problem solving was regarded as a different competence to be taught in the curriculum, instead of part of the learning itself.

In terms of attitude, both curricula suggest the importance of building students' motivation and interest, developing their thinking, confidence and cooperative attitudes and the precise aspects of mathematics.

The Dutch curriculum expectation on students' attitude is:

"Explanations, formulations and notations, as well as the giving and receiving of criticism, are all part of a specifically mathematical method that will teach children **to organize and motivate ways of thinking and to avoid mistakes, independently as well as together with others**" (SLO, 2004, p.5)

The Indonesian curriculum expectation on students' attitude is:

"...to apply the concepts or algorithms **flexibly, accurately, efficiently and correctly** in problem solving… appreciate the use of mathematics in real life which include **developing curiosity, attention and interest in learning mathematics as well as tenacious attitude and confidence** in problem solving" (BSNP, 2006, p.417)**.**

5.1.3 Content of the Curriculum

While the Dutch curriculum comprehensively underlines the importance of how the learning process is expected to be conducted, it only globally describes how the contents should be covered during the six years of primary education. In general, the curriculum covers three domains, namely mathematical insights and operation, numbers and calculation, and measurement and geometry. Below is the curriculum expectation of the mathematical content, for each domain, to be covered in the six years of primary grades (SLO, 2004, p.5):

"Mathematical insight and operation:

1. The pupils learn to use mathematical language.
2. The pupils learn to solve practical and formal arithmetical and mathematical problems and clearly represent argumentation.

3. The pupils learn to motivate approaches for solving arithmetical/mathematical problems and learn to assess solutions.

Numbers and calculations:

4. The pupils learn to understand the general structure and interrelationship of quantities, whole numbers, decimal numbers, percentages, and proportions, and to use these to do arithmetic in practical situations.

5. The pupils learn to quickly carry out basic calculations in their heads using whole numbers, up to 100, whereby adding and subtracting up to 20 and the multiplication tables are known by heart.

6. The pupils learn to count and calculate using estimation.

7. The pupils learn clever ways to add, subtract, multiply and divide.

8. The pupils learn to add, subtract, multiply and divide on paper, according to more or less contracted standard procedures.

9. The pupils learn to use the calculator with insight.

Measuring and geometry:

10. The pupils learn to solve simple geometrical problems.

11. The pupils learn to measure and calculate using units and measurements, such as time, money, length, circumference, surface area, volume, weight, speed, and temperature."

As can be seen from the above, the mathematical contents are only briefly described, without specifically mentioning what topic should be taught in which semester, or in what year. Besides, the descriptions of the content, particularly within the mathematical insight and operation domain, attempt to re-emphasize the curriculum expectations on the mathematical skills described in an earlier section. For instance, it mentioned the importance of learning to competently form an argument and to assess a solution. However, as the curriculum does not set what topics should be delivered in what year, the textbooks provide a more detailed guideline of curriculum implementation. For example, according to the textbooks, in grade one, Dutch students will learn the numbers up to 20, strategies to do operations or calculations using the numbers and the concepts of measurement and geometry that can be incorporated within this topic. This will be discussed further in section 5.3.

Grade/ Semester	Standard Competence
Grade 1/Semester 1 Grade 1/Semester 2	**Numbers** 1. Do addition and subtraction up to 20 **Geometry and Measurement** 2. Use the measurement of time and length 3. Learn various three dimensional objects **Numbers** 4. Do addition and subtraction of two-digit number (up to 100) in problem solving **Geometry and Measurement** 5.Use the measurement of weight 6 Learn various shapes
Grade 2/Semester 1 Grade 2/Semester 2	**Numbers** 1. Do addition and subtraction up to 500 **Geometry and Measurement** 2. Use the measurement of time, length and weight in problem solving **Numbers** 3. Do multiplication and division of one-digit and two-digit numbers. **Geometry and Measurement** 4. Learn the elements of simple shapes
Grade 3/Semester 1 Grade 3/Semester 2	**Numbers** 1. Do operation of numbers up to three-digit numbers. **Geometry and Measurement** 2. Use measurement of time, length and weight in problem solving. **Numbers** 3.Learn simple fractions and its application in problem solving **Geometry and Measurement** 4.Understand the elements and properties of various shapes 5. Calculate the perimeter and area of square and rectangles and their application in problem solving
Grade 4/Semester 1 Grade 4/Semester 2	**Numbers** 1. Understand and use the properties and rules of the operations of numbers in problem solving 2. Understand and use the factors and multiple in problem solving **Geometry and Measurement** 3. Use the measurement of angles, length, and weight in problem solving 4. Use the concept of perimeter and area of various shapes in problem solving

	Numbers 5. Add and subtract the whole numbers. 6. Use fractions in problem solving. 7. Use the symbol of Roman numbers. **Geometry and Measurement** 8. understand the properties of three dimensional space and the relationships between shapes.
Grade 5/Semester 1 Grade 5/Semester 2	**Numbers** 1. Do whole numbers operation in problem solving **Geometry and Measurement** 2. Use the measurement of time, angles, distance and speed in problem solving 3. Calculate the area of simple shapes and apply it in problem solving. 4. Calculate the volume of cubes and cuboids and use it in problem solving **Numbers** 5. Use fractions in problem solving **Geometry and Measurement** 6.Understand the properties of geometrical shapes and their relationship
Grade 6/Semester 1 Grade 6/Semester 2	**Numbers** 1. Do operation of whole numbers in problem solving **Geometry and Measurement** 2. Use the measurement of volume (and debit) in problem solving 3. Calculate the area of polygons, circles and the volume of prism **Data Analysis** 4. Collect and analyse data **Numbers** 5. Do operation of fractions in problem solving **Geometry and Measurement** 6. Use the coordinate system in problem solving **Data Analysis** 7. Solve problems that related with data

Table 5.1 Mathematical contents suggested by Indonesian curriculum

Unlike the Dutch curriculum, which does not apply centralized decisions, the Indonesian curriculum is heavily centralized in terms of mathematical content to be covered. The curriculum rigorously sets all topics that should be introduced during the six years of primary grade education, and in which grades and semester the topics needs to be taught. There are three domains of mathematical content taught to the students in the primary grades: numbers, geometry and measurement, and data analysis. In the Netherlands, data analysis is not explicitly listed in the current curriculum guide, however, according to van den Heuvel-Panhuizen and Wijers (2005), there was an attainment target in the earlier curriculum version (1993/1998), which specified this topic under the measurement strand. As cited in their study (p.294), "… can read simple tables and diagrams, and produce them based on own investigations of simple context situations".

Grade 1 Semester 1 **Competence standards**	**Basic Competence**
Numbers 1. Do addition and subtraction up to 20.	1.1 Counting up to 20 1.2 Ordering the numbers up to 20 1.3 Addition and subtraction up to 20 1.4 Problem solving of numbers up to 20
Geometry and Measurement 2. Use the measurement of time and length	2.1 Defining times, day and hours. 2.2 Determining the duration 2.3 Measuring length of objects through everyday sentences (short, long) and comparing them 2.4 Problem solving of measurement of time and length
3. Learn various three dimensional objects	3.1 Grouping three dimensional objects 3.2 Ordering the objects based on its size
Grade 1 Semester 2 **Competence standards**	**Basic Competence**
Numbers 4. Do addition and subtraction of two-digit number (up to 100) in problem solving	4.1 Counting up to 100 4.2 Ordering the numbers up to 100 4.3 Place Value: Tens and Ones 4.4 Addition and subtraction up to 100 4.5 Associative and Distributive Law 4.6 Problem solving of numbers up to 100
Geometry and Measurement 5.Use the measurement of weight	5.1 Comparing weights 5.2 Problem Solving of measurement of weights
6 Learn various shapes	6.1 Triangles, Four Sided-Object and circles 6.2 Grouping the shapes

Table 5.2 Basic competence suggested by Indonesian curriculum (grade 1)

The distribution of the topics (standard competences) in the Indonesian curriculum is presented in table 5.1 above (BSNP, 2006, p.149-158) in which each standard competence is divided into several basic competences. For grade one, the content is presented in table 5.2. In the table, it can be seen that the curriculum suggests problem solving to be a different competence to be taught at the end of a topic.The coverage of the contents is compulsory for all schools, within the given time period.

5.1.4 Discussion

From the above, the similarities and differences in terms of the aims and the contents of the two curricula become visible. Both curricula aimed to equip students with a good knowledge of mathematics and its application in contextual situations. They also aimed to equip students with the skills to understand mathematical concepts and to develop their communication and problem solving skills. In terms of attitudes, the curricula also stressed the importance of building students' motivation and interest, developing their thinking, confidence and cooperative attitudes, as well as the precise aspects of mathematics.

However, there are some remarkable differences between the two. Firstly, there is the absence of centralized decision making on what mathematical contents should be taught at Dutch schools. In contrast, the Indonesian curriculum is heavily centralized. The contents, sub-contents, and the time allocation have all been determined by the central government (BSNP). Secondly, unlike the Indonesian curriculum which adopts a content-based approach, the Dutch curriculum is more flexible on what contents are to be taught during the primary grades. It seems that the emphasis of the Dutch primary mathematics curriculum is not on the mathematical content to be taught but rather on the cognitive development of the students. Thirdly, in the Indonesian curriculum, problem solving is advised to be taught only when students have obtained the necessary knowledge. The curriculum advised problem solving as a different competence to be taught at the end of each topic. Fourthly, while both curricula expect students to learn algorithms and standard procedures, the Dutch curriculum particularly suggests students (probably at the upper grades) to learn how to use a calculator. Thus, the machine can compute the result of a given task, but the process on how to get the answer should be understood by the students. These similarities and differences are further discussed, in their relation to the consistency between RME and the curricula, as below.

1. Reality Principle

Both curricula suggest the importance of using a contextual situation to introduce the current mathematics concept. According to the Dutch curriculum, the origin of such situations can be from everyday life, the application of mathematics in other subjects, or in its relation with another mathematical concept. In Indonesia, however, while the importance of initiating a lesson with a contextual problem is stressed, the curriculum suggests problem solving to be taught at the end of each topic, only after students have mastered the necessary concepts. While it is true that RME suggests the contextual problems to be used both as a starting point of learning and as an application of a mathematical concept, in fact, the exploration of mathematics or problem solving is expected to be an integrated part of the learning activities, not as a different competence to be taught (Van den Heuvel-Panhuizen, 2000).

2. Level Principle

Both curricula also emphasize the use of models in learning mathematics. These may include concrete objects, manipulatives, models, schematization and tools. In the curricula, students are expected to understand mathematical notation, symbols, tables, diagrams, and use media or tools to support evidence in problem solving, or in developing the mathematical language. However, while the Dutch curriculum is aimed at introducing the use of a calculator, the Indonesian curriculum is not encouraging the introduction of such tools into the primary education. This difference might also influence how mathematics is taught in the two systems. On one side, it is based on the assumption that a calculator can compute the result of a given task, and thus, the importance of learning the mathematical operation is to understand the process and how to interpret the result. On the other hand, one is based on the assumption that the calculation skill is part of the concept mastery, and practice is important. In this view, the use of instruments such as a calculator might interfere with students' understanding of the mathematics.

3. Activity and Guidance Principle

In relation to the activity and guidance principle, both curricula suggest mathematics teaching and learning process should actively involve students and teachers should play the important roles of providing appropriate guidance and instructions. In Indonesia, however, the guidance given by teachers is expected to help students to 'gradually master the mathematical concepts', which seems to be placed as the most important goal of the learning process. On the other hand, the guidance expected by Dutch curriculum is in the form of "taking students interest, ability and topicalities into account when selecting mathematical activities so as students feel challenged and satisfy in learning mathematics at their own level" as the curriculum aims to address the intelectual development of the individual student. This is in line with RME ideas, as Van den Heuvel-Panhuizen and Wijers (2005) pointed out, it is not necessary for all students to learn mathematics at the same level at the same time. In an individualist society such as the Netherlands, it can be understood that an intrinsic motivation is nurtured through meaningful learning. On the other hand, Indonesian curriculum did not explicitly suggest this aspect. This can be understood that in a collectivist society, such personal interests are often limited or de-emphasized.

4. Interactivity Principle

In relation to the interactivity principle, the two curricula suggest that students should be helped to develop their communication abilities. The Dutch curriculum, however, explicitly characterized some expectations of how interaction, particularly horizontal interaction, should be conducted. It encourages the training of giving argumentation and critiques, as well as providing justification since early grades as suggested by Yackel and Cobb (1996). In Indonesia, the curriculum also expects teachers to help students to develop their communication abilities, but again, it does not explicitly advise how communication should be nurtured. The difference, in terms of an explicit expectation of the needs for training to express one's opinion, might be related to how communication is expected to be carried out throughout the larger society. In the Netherlands, and other western countries, training students to express their opinions is often tolerated and regarded positively as standing up for one's beliefs. On the other hand, such training might not be appreciated similarly in Indonesian society which values harmony (Farver et al., 1997).

5. Intertwinement Principle

In regard to intertwinement principle, the two curricula actually expect students to learn the relationships between mathematical concepts. However, the content-based approach adopted by the Indonesian curriculum may limit the implementation of this principle. The Indonesian system is actually still very conservative towards how mathematics content should be organized in the curriculum. Moreover, there is a rigorous expectation and instruction about how the curriculum should be operationalized in the classroom. In the Netherlands, on the other hand, mathematics and its organization in the curriculum are viewed more flexibly, thus making connections between various mathematical strands possible without having to follow any prescribed order.

From the above, it can be seen that there are both consistencies and inconsistencies between RME and the curriculum descriptions of the two systems. While most of RME principles are reflected in the Indonesian curriculum, the descriptions were often very general and less explicit compared to the Dutch curriculum. They were also limited by the content-based approach as well as by the centralized decision making process of the contents to be taught. These findings may explain the findings of past studies that remained inconclusive.

On one hand, the findings in this study confirm previous studies (Widodo, 2011; Dhoruri, 2010) that highlighted the consistency between RME and the Indonesian curriculum, in terms of its emphasis on the importance of using contextual problems and manipulatives, as well as promoting problem solving and active learning. However, the findings in this study also support that of Johar et al. (2017). They argued that the structure of the Indonesian curriculum has lead students to have a single approach to solving mathematical problems. Nonetheless, as the curriculum description provided in the documents are quite general, section 5.3 will specify how the curriculum is operationalized in the textbooks.

5.2 The Intention of the Curriculum Developer

To better understand the intentions of the curriculum official during the development of the documents in general, and in particular in adapting RME, the researcher interviewed the head of the Mathematics Section in the National Curriculum Center, Jakarta. As aforementioned in chapter four, the aim of the interview with the curriculum official was to supplement the document analysis discussed above. The themes of the interview included the background of the curriculum design, the references used in the curriculum development, RME adoption in the curriculum, centralization of decision making on curriculum content, and support for the curriculum implementation.

Background to the Drawing up of the Curriculum

According to the official, the 2006 curriculum version is an improvement of the earlier 2004 competence-based curriculum. In this curriculum version, the government introduced the standard competences and the basic competences as the minimum standards to be attained.

This change was also influenced by the political condition at the end of 2004, after the 2004 curriculum had just launched, there was a cabinet reshuffle following the result of presidential election. In fact, the standards set by the government guided the standardized examination which applied to all types of schools.

The official also mentioned that the curriculum reform was not specific to mathematics education. Therefore, the framework adopted in the 2006 curriculum development was not subject-specific. Instead, it was generally applied to all subjects and the subject-specific team would derive the general framework to be applicable to their respective field. The current curriculum also suggests the teaching and learning for the first three year of primary school should utilize what so called ‘thematic approach’. By thematic approach, teachers are expected to link the teaching of various subjects, including language, arts and mathematics, under a central theme. The contents and curriculum expectation of each subject, however, were described separately. Table 5.1 and 5.2 show that for mathematics. This ‘thematic approach’ was not explained explicitly in the curriculum document, however, it has been introduced in various teachers development programs and included in the review process of the BSE textbooks.

References in the Mathematics Curriculum Development

In response to the researcher's questions about the references used in the curriculum development, the official described that there were two major references that influenced the development of the 2006 mathematics curriculum. They are the National Education Goals no. 20 Year 2003, which is written in relation to the National Education System, and the trends of mathematics education practices in other countries. As he said in response to "What are the main references used by the curriculum team in developing the current mathematics curriculum?"

> "In the amendment of curriculum, we use the National Educational Goals as our main reference, particularly the goal no.20 year 2003. This is applicable to all subjects, the overall design of curriculum. Besides, we also follow the current trends of mathematics education globally."

The National Educational Goals no. 20 Year 2003 can be read as,

> "The national education serves to develop the ability and to form the character as well as the civilization of the dignified nation in order to educate the nation, **aimed to developing the pupils' potentials to have Godly character, noble, healthy, knowledgeable, skilled, creative, independent, and become democratic and responsible citizens**".

With this goal of national education, it can be seen that while developing individual mathematics ability is important, the real emphasis of education in a collectivist society like as Indonesia, is to empower the individual so they may contribute to the nation. As for the trends of mathematics education globally, he underlined that the curriculum aims to adopt the humanistic approach in teaching and learning mathematics, or the idea of teaching mathematics meaningfully to the students. This idea is also offered by some theories such as RME, contextual teaching and learning, and mathematics in contexts. He further refered to a document entitled '*Kajian Kebijakan Kurikulum Mata Pelajaran Matematika*', or 'A Study of the Mathematics Curriculum Policy' (*Puskur*, 2007). This document mentioned that the teams had reviewed the educational practices in other countries as one of their references in the development of the newest curriculum version. Those countries which were regarded as developed were considered as implementing a more contextual and humanistic approach to mathematics education. According to the official, the team has reviewed the trends of mathematics education in some countries such as the Netherlands, the United States, Japan, Singapore and Australia.

RME Adoption in the Curriculum

The official emphasized that it was not their intention to describe any didactical approach, however, the RME approach was among the references consulted in the mathematics curriculum development, as he described to the question: Is there any specific educational model or theory adopted in the curriculum?

> "It is not our intention to describe any educational approach in the curriculum. However, I could say that there are some approaches or models that were reviewed, such as the Contextual Teaching and Learning approach, Mathematics in Contexts, Realistic Mathematics Education, and Open-Ended approach".

In the policy document, the official described the five tenets of RME as follows (Puskur, 2007, p.3):

> "... in order to improve the low mathematical activity and achievement, nowadays there are some studies conducted on how to teach

mathematics in a contextual and humanistic way, as have been implemented earlier in some developed countries. For example, in the Netherlands, there has been developed an educational approach, namely the **Realistic Mathematics Education (RME).** There are five main characteristics of RME approach: (1) using students' experiences in daily lives (2) visualizing the reality into models, and then shifting the model through vertical mathematization before they reach the formal form, (3) using students' activities, (4) in realizing the mathematics in the students, it is necessary to conduct discussion and question-answer, and (5) there is an intertwining between concepts, or between topics so the mathematics teaching and learning can be more holistic than partial (Ruseffendi, 2003). Utilizing this approach, it is expected that there will be improvement of student outcomes and mathematical activities which can be achieved by delivering materials that is close to the daily lives."

As shown above, the curriculum consults the five tenets of RME (see Gravemeijer, 1994) as the important principles for the teaching and learning of mathematics. This includes the use of students' informal knowledge, the use of models to scaffold learning from informal to formal mathematics, the importance of a student-centered approach, classroom interaction and making connections between various mathematical concepts. However, instead of referring to the original Dutch articles and sources, the curriculum refers to a source by an Indonesian Professor who was among the initiators of the PMRI movement in the country. Although it only mentioned the tenets briefly, it can be seen that the emphasis was on the importance of the use of real-life problems as suggested by the reality principle of RME. Interestingly, in the latter part of the same page, the curriculum also acknowledges the domestic dissemination and development of the Indonesian-version of RME (PMRI), as it says, "Besides, in Indonesia, particularly in the primary grades, an instructional theory, namely '*Pendidikan Matematika Realistik Indonesia*' or abbreviated as PMRI, has been disseminated".

According to the official, the acknowledgement that PMRI had been widely disseminated was made because of the massive dissemination of the movement that had been done since the early 2000s, in which he was often invited to socialization programs. Besides, some PMRI experts have been actively involved in the whole curriculum development process, as he described to the question: Who was involved in the curriculum development other than the team from the curriculum center? Was there any PMRI specialists involved?

> "In developing a curriculum, we involved practitioners, school teachers as well as some experts. By experts, they are the lecturers in teacher college (LPTK) and mathematicians in the university... Some of them I know that they were also among **PMRI specialist**"

In this process, the curriculum team invited many stakeholders, including teachers, lecturers and professors from the teacher education college (LPTK) as well as lecturers and professors who have expertise in the pure mathematics. Interestingly, the teacher educators who were invited include some of the initiators of the PMRI movement. According to the official, they made significant contributions to how the curriculum looks now.

Centralized Decision Making on the Curriculum Contents

According to the officials, the government needs to set a centralized system for the standard content to be delivered in schools all over the country. In fact, this content-based approach was among the aspects that the PMRI scholars were most concerned to reform, but this regulation was not within their area of responsibility. A higher government body, namely the BSNP, has set the contents and sub-contents, as well as the time allocation of all subjects taught. This centralized approach to contents aims to serve as a guide to the teaching and learning of mathematics all over the country as at the end of the school year students have to complete a standardized examination also organized by the BSNP.

Supports for Curriculum Implementation

According to the official, the schools are supported by BSE textbooks to implement the curriculum. These textbooks were also approved and reviewed by the BSNP. The analysis of the textbook will be discussed in the following section. Furthermore, there were also a number of trainings and socialization programs aimed to help teachers understand the curriculum. These training seminars were organized by the center, or by some teacher educational college. They were different from the in-service teacher development programs conducted by PMRI teams.

From the above, the involvement of some PMRI experts in the curriculum development may explain why RME principles are reflected in the curriculum, as discussed in an earlier section. Besides, the Netherlands was also among the countries that regarded as developed in their mathematics education, and therefore the curriculum officials used the practice of this country as one of their references and sources of insight when designing the curriculum. In fact, the curriculum did not have any intention to describe RME, or any particular didactical approach. Moreover, the content-based approach and the centralized decision making of the contents to be taught have been pre-determined by the BSNP. The curriculum development thus has to comply with this standard. This standard also serves as a guideline for the standardized examination which is designed and administered by provincial and central government.

5.3 RME Reflected in the Textbooks

The aim of the textbook analysis presented in this section is twofold. Firstly, it serves as a means to understand how the curriculum is being operationalized. Secondly, it aims to serve as a background for the analysis in the following chapters. In terms of the second, as the only topic covered in the classroom observation in Jakarta (see chapter seven) is addition and subtraction in grade one, the analysis presented in this chapter focuses only on this.

Three textbooks, *De Wereld in Getallen* (DWiG) 3b1 for grade one (*groep* three in Dutch school), the PMRI textbook and the BSE textbook for grade one were analyzed and compared. In one volume, the DWiG textbook has two sides. On one side (the blue side), it is a lesson book which contains general tasks to be solved. On the other side (the red side) is a workbook which contains tasks for individual students to solve. The latter provides differentiated tasks for students with different abilities. The tasks studied in this study are the general tasks in the blue side (*lessen*). The DWiG 3b1 covers two blocks (seven weeks) of lessons in semester two, which is comparable to the PMRI book for grade one in period five and six in semester two that covers (more or less) the same number of weeks and lessons. As for the BSE textbook, it adopts a content based approach, and there are two chapters related to addition and subtraction in grade one. Each chapter is associated with a theme. For example, the themes related to the two chapters on addition and subtraction are ‘My Self’ and ‘My Favorite Fruits’. The theme, however, is very general and the presentation of the chapter did not show the relation between the theme and the mathematical topic. The results and discussion of the analysis is presented below.

5.3.1 The Final Version of the Textbook Analysis Framework

As described in chapter four, the analysis of the textbook employed a modified framework from van Zanten and van den Heuvel-Panhuizen (2015). This framework has been utilized to analyze some RME and pre-RME (non-RME) textbooks in the Netherlands. The unit of analysis is 'a task' that requires an answer from the student. According to this framework, there are three major perspectives to be studied: the content, performance expectation, and learning facilitator. As their study focused on the decimals topic in upper primary grades, while the present study is focusing on the number and operation in grade one, some modifications have been made. In terms of content, there are three sub-categories: addition and subtraction problems involving measurement, addition and subtraction problems involving money, and addition and subtraction problems of numbers (without any application in other strands). They are labeled as measurement, monetary and numbers. In terms of performance expectations, there are three sub-categories: mental calculation, estimation and written calculation (digit-based algorithmic processing). In terms of learning facilitators, the analysis would see if the textbook promotes the use of contexts, the use of models and schematizations (number line, charts, table), and the use of one's own productions.

5.3.2 Analysis of the Textbooks

In terms of mathematical content, the addition and subtraction topic introduced in the DWiG textbook involve numbers up to 20, while in the PMRI textbooks it involved numbers up to 50, and in the BSE textbooks it involved numbers up to 100. According to the framework, the content of the tasks presented in the three textbooks are summarized in table 5.3 below:

Sub-Categories	DWiG	PMRI	BSE
Numbers	528 (85%)	408 (94%)	126 (100%)
Measurement	24 (4%)	0	0
Monetary	63 (11%)	24 (6%)	0
Total	615 (100%)	432 (100%)	126 (100%)

Table 5.3 Contents of 'addition and subtraction' tasks in the textbooks

In terms of the number of tasks provided in each textbook, the DWiG textbooks outnumbered the other two. Moreover, as shown in table 5.3 above, the tasks in the DWiG textbook are distributed across three subcategories, although mostly concentrated on the number strands with the remaining distributed between measurement and monetary strands. In the PMRI textbooks, a few tasks involved monetary application problems. However, the tasks within the 'number in monetary problems' category presented in the PMRI textbook can be regarded as inappropriate. The textbook suggests the use of Indonesian currency to learn numbers up to 20. Here, unlike the Euro currency which has coins of €1 and €2 as well as bank notes of €5, €10, and €20, the Indonesian currency uses much larger denominations, such as Rp1000, Rp2000, Rp5000 and so on. Here, Rp1000 is represented by one 'thousand', 2000 is represented by two 'thousand', and so on. An example of the task in this category is shown below in Figure 5.1.

Figure 5.1 Task involving monetary problems in the PMRI textbook (The pictures: “A small bar of chocolate costs 1 thousand rupiah, a big bar of chocolate costs 2 thousand rupiahs, and a mini bread cost 3 thousand rupiahs.” Instruction: “Please fill in the blanks. I have … rupiah. I buy …, so now I have … rupiah left.”)

In contrast to the other two textbooks, the tasks provided in the BSE textbook were 100% within the numbers strands. None of the tasks are presented in relation to measurement or monetary problems.

In terms of performance expectations, there are three sub-categories: mental calculation, estimation and written calculation (digit-based algorithmic processing). The analysis of the tasks in the three textbooks under this category are shown in figure 5.2. The analysis showed that the addition and subtraction tasks provided in the three textbooks are mostly classified within the ‘mental calculation’ category. In the PMRI textbook, 100% of the tasks fall within this category. In the DWiG textbook, some tasks also require students to do estimation (4%).

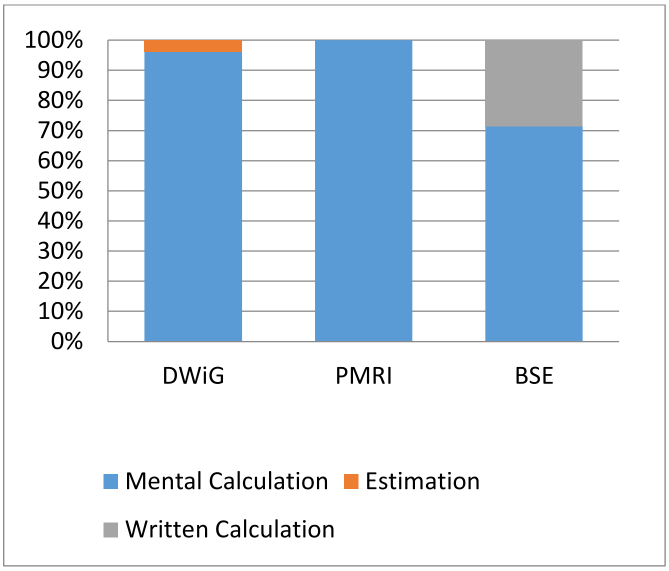


Figure 5.2 Performance expectation of the ‘addition and subtraction’ tasks

However, in the BSE textbooks, there are a significant number of tasks (29%) that required students to do a written calculation. An example of this type of task is shown in figure 5.3 below:

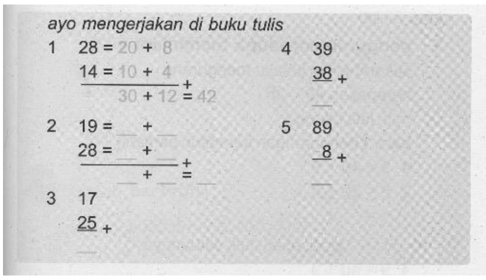


Figure 5.3 Written calculation task in BSE textbook (The instruction says “*Please do the following tasks in your note book*”)

In terms of learning facilitators, which has a qualitative nature, the analysis involved seeing if the textbook promotes the use of contexts, use of models (number line, charts, table), use of different calculation methods and the use of one’s own productions. The summary of the analysis is shown in table 5.4 below:

Sub-Category	DWiG	PMRI	BSE
Use of Context	As source of learning and for application	As source of learning and for application	For application
Use of Scheme and Models	Yes	Yes	Yes
Use of own production	Yes	Yes	No

Table 5.4 Learning facilitators of the tasks in the textbooks

Some examples of the tasks representing each learning facilitator (didactic supports) are discussed below.

Use of Context

In terms of the use of context, this study examined if the tasks are simply in the form of a bare number problem or if they involve contextual problems. The results are shown in table 5.5:

Use of Contexts	DWiG	PMRI	BSE
Bare Number Problems	385 (62%)	339 (78%)	107 (85%)
Problems with Context	230 (38%)	93 (22%)	19 (15%)
Total	615 (100%)	432 (100%)	126 (100%)

Table 5.5 Use of contexts in the 'addition and subtraction' tasks

As shown in table 5.5, both the DWiG and PMRI textbooks provide a significant number of contextual tasks. However, in the BSE textbook, 96% of the tasks are bare number problems. An example of a contextual problem from DWiG textbook is shown in figure 5.4:

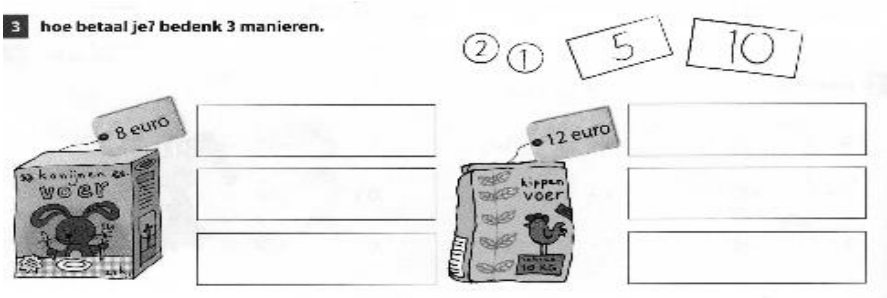


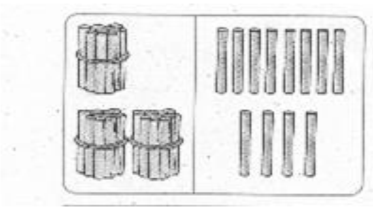
Figure 5.4 Contextual problem in DWiG textbook (Translation: *How do you pay? Think of 3 ways*)

The above example was aimed at introducing the strategy of decomposing numbers up to twenty and, at the same time, introducing the currency denominations. The task was presented in the beginning of the lesson, and therefore, can be used as a source for learning. In the BSE textbook, however, the contextual problems were generally provided after the introduction of the concept. The context is only utilized as an application, instead of a source for learning. An example of ta BSE textbook task is shown in Figure 5.5 below:

Figure 5.5 Contextual problem in BSE textbook (The tasks: "Five baskets of oranges with ten oranges in each basket and eight oranges is equal to …". The task expects students to use tens unit [*puluhan*] and ones unit [*satuan*] in answering the question)

Use of Schemes and Models

The three textbooks encouraged the use of schemes and models to solve a given task. The proportion of tasks involving a model or scheme in each textbook is 42% (260 tasks), 35% (130 tasks) and 70% (89 tasks), for DWiG, PMRI and BSE textbooks respectively. Given the percentage of tasks involving a scheme or model in the BSE textbook is very high, the models and schemes led to the use of standard methods as shown in figures 5.6 and 5.8:



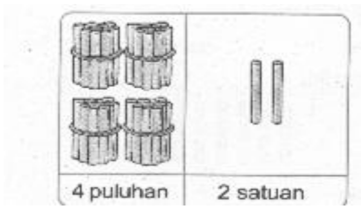


Figure 5.6 Wooden sticks structured in tens [*puluhan*] and ones [*satuan*] as a model to learn 'addition and subtraction' in BSE textbook (Problem: Calculate '18 + 24)

Interestingly, a similar structure using tens and ones also appears in the PMRI textbook as shown in figure 5.7 below:

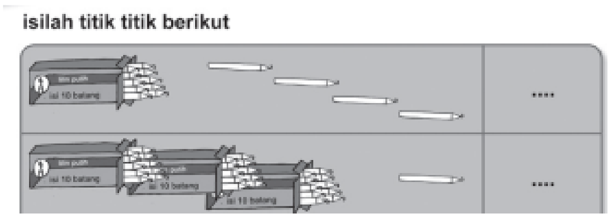


Figure 5.7 Structured of tens and ones as a model to learn 'addition and subtraction' in PMRI textbook (Translation: Fill in the blanks)

In the BSE textbook, the above example (figure 5.6) is directly followed by the introduction of the standard method, as shown in figure 5.8 below:

4 pengurangan

a pengurangan tanpa meminjam

bersusun panjang	bersusun pendek
57 = 50 + 7	57
23 = 20 + 3 _	23 _
34 = 30 + 4	34

b pengurangan dengan meminjam

bersusun panjang	bersusun pendek
30 10	3 10
42 = ~~40~~ + 2	~~4~~ 2
9 = 0 + 9 _	9 _
33 = 30 + 3	3 3

Figure 5.8. Standard Methods Suggested by BSE Textbook [*Translation: "Subtraction. (a) subtraction without bridging 10: Column method (long and short); (b) subtraction with bridging 10; Column method (long and short)]*

On the other hand, the DWiG textbook introduced the split table and arithmetic rack as tools to solve the addition and subtraction problem up to twenty. An example of the arithmetic rack and double structures to solve addition and subtraction problems is shown in figure 5.9:

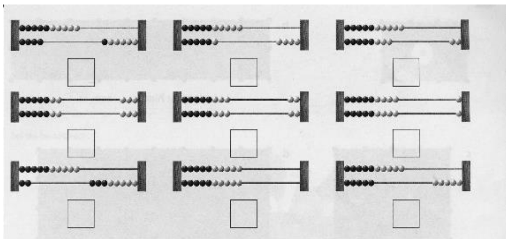


Figure 5.9 Arithmetic Racks in DWiG Textbook

With rigorous examples shown above, it is not surprising that some tasks given in this topic requires students to do written calculation as shown in figure 5.3.

Use of Own Production

As for the last category, both DWiG and PMRI textbooks provided a few tasks that allow students to create their own problems and then answer them. There are 24 tasks in the DWiG textbook and six tasks in the PMRI textbook which promote this aspect. Interestingly, in both textbooks, this type of problems is presented in the tasks within the application of numbers to monetary problems. In the DWiG textbook, an example of this type of task is similar to that shown in figure 5.4 above, with students free to create their own problems.

5.3.3 Discussion

From the above, some similarities and differences between the three textbooks in terms of content of the tasks, performance expectation of the tasks and the learning facilitator of the tasks, all within the addition and subtraction topic, have been identified. In this section, these findings are used as the basis to discuss the consistency between the textbooks' features and the RME ideas (except the interactivity principle that may not be applicable in the textbook analysis framework employed in this study):

1. Reality Principle

    From the findings of the tasks content as well as on the use of the context, it can be seen that the PMRI textbooks have adapted the reality principle of RME. In the BSE textbook, this aspect is in fact almost missing. This can be seen from the high percentage of tasks in the textbooks that are bare number problems. Moreover, contexts in this textbook were simply utilized as an application rather than as source for learning.

    Unsurprisingly, instead of using a Dutch context, the tasks in the PMRI textbook were adapted to local Indonesian contexts. However, the adaptation was not always appropriate and so need to be re-considered. For example, simply replacing the context of Euro with Rupiah for teaching addition and subtraction of numbers up to 50 can be considered as inappropriate. This shows how the same context in different education systems may not give the same meaning or mathematize a certain mathematical concept similarly. In the DWiG textbook, this type of task (application in monetary problems) indeed allows students to bring into their solution quite specific real-world knowledge, while in the PMRI textbook similar task were rather confusing as they only learned numbers up to 100 while the currency denominations began at one thousands.

2. Level Principle

Both the DWiG and PMRI textbooks have also adopted most ideas of using schemes and models as suggested by RME theory that encourages students to use 'flexible' strategies. In contrast, the BSE textbooks introduced more fixed schematization and models. This difference was also found to be linked to the nature of the 'performance expectations' of the tasks. Here, the BSE textbook expects students in grade one to work on a significant number of tasks that require them to provide written calculations using algorithms or standard method, rather than simply solve the problem using a mental calculation strategy or estimation. Interestingly, some models (such as the tens and 'ones' structure using wooden sticks) presented in the BSE textbook also appear in the PMRI textbook.

3. Activity and Guidance Principle

Although not significant, both the DWiG and PMRI textbooks provide a few tasks that allow students to perform 'own production' style problem solving. In the BSE textbooks, this feature is missing. The tasks provided in the textbook were mainly aimed at calculating simple addition and subtraction problems as shown in figure 5.3. In terms of guidance, the DWiG and PMRI textbooks do not provide much guidance for students. In contrast, the BSE textbook provides a lot of guidance to students, such as giving a series of rigorous examples and the prevalent use of rules or standard methods to solve addition and subtraction tasks. In fact, as discussed earlier, the tasks provided also did not give an opportunity for students to use a ‘flexible’ strategy. For example, the tasks in figure 5.3 show the textbook already specifying how the tasks should be solved, in a fixed way.

4. Intertwinement Principle

Both the DWiG and PMRI textbooks incorporated the intertwinement principle in their design, which can be seen in the tasks that involve the application of numbers in measurement as well as in the monetary problems. In contrast, the BSE textbook adopted a content-based approach. Accordingly, the teaching of a mathematical topic, such addition and subtraction, only focused on that particular content. The measurement and the monetary topic were situated separately in other chapters.

In addition to the above findings, this study also identified some aspects that were not covered by the framework from van Zanten and van den Heuvel-Panhuizen (2015). Firstly, some topics in the Indonesian curriculum were not covered in the PMRI textbook. This contradicts some reports in Amin, et al. (2010) who reported the PMRI textbook was developed based on the national curriculum. Here, the PMRI textbook only introduces numbers up to 50, instead of up to 100 as suggested by the curriculum. On the other hand, the PMRI textbook also covers topics that are not mandated by the curriculum, such as the monetary topics suggested to be taught later in grade three, when students have learned three-digit and four-digit numbers. The PMRI textbook is found to be more in line with the Dutch curriculum, to a great extent. This could actually be anticipated as this textbook was greatly inspired by the Dutch textbook, which of course was developed to support their curriculum goals.

Secondly, the PMRI and BSE textbooks do not provide supplement workbooks for students with different abilities, while the DWiG textbook does (see appendix 5). The tasks were uniformly given to all students. In the BSE textbook, this feature is also missing. In terms of task differentiation, the collectivism in Indonesian society might explain why this approach might not be appropriate, and thus was not chosen by the textbook writers. Unlike the Dutch who highly valued individual differences, Indonesian society prefers uniformity to be fair for everyone.

5.4 Intention of the Textbook Writer

While the curriculum adopted some RME ideas, the analysis above shows that many aspects of the BSE textbook were not in line with RME ideas. Therefore, the researcher conducted an interview with the BSE textbook writer to better understand the aim of their textbook writing process, the use of sources and references, and the task selection and design. Most importantly, the interview aimed to understand if the writer is familiar with, and has knowledgeable of, RME or PMRI. As for the PMRI textbook, the analysis in the previous section considered it adequately applied RME ideas to the textbook, hence, no interview was conducted with the PMRI textbook writer.

This interview was with one of the textbook writers who has been working with the center for more than ten years. The writer was contacted and interviewed, based on a recommendation from the National Textbook Center. The textbook writer is a primary school teacher himself and has been teaching for almost 15 years.

The Aim of the Textbook

According to the writer, BSE textbook was designed to address both teacher and student needs. It serves as a teacher book, and at the same time as a student book. Thus, as the book functions as both a teacher book and student book, he thinks it is important to give suggestions to the teacher, and at the same time, give independent tasks for the students to work on, as he described to the question: What was the aim of the textbook you have written? For example, is it mainly a student book or a teacher book?

> "In developing the textbook, I consider the practicality. The main aim of the textbook is as a source of teaching materials. However, in our curriculum (2006), it serves both as teacher and student book. I introduce the mathematical concepts and at the same time provide tasks for students in the same book."

The textbook writer mentioned the textbook was developed mainly to give ideas to teachers on what contents to be taught. He did not intend to provide suggestion in terms of methods to be used in delivering the materials.

The Use of Sources and References

The author mentioned that he used his experience as a teacher to develop the textbook, while using the curriculum document as his main reference. During the textbook writing, it was also important that he complied with the contents and standards set by the BSNP. In particular, in response to the question "What are your references in writing the textbook?" he commented that he used the curriculum document, in terms of contents and competencies to be taught, as the main guideline for developing the textbook. As he answered:

> "I use the national curriculum as my main guidelines... I have a lot of references. Among all, I use the old textbooks, from different versions as well as the imported textbooks that available in our country, such as those from Singapore."

Additionally, he used some theories such as contextual teaching and learning, which he learnt during his education in Teacher College. In selecting the tasks, he also looked at earlier versions of the Indonesian textbooks (developed over the past few years) and from some the Singaporean mathematics textbooks for inspiration.

Task Selection and Design

The textbook writer explained that he used similar patterns to write each chapter of the textbook. They usually start with an opening story to motivate students. This is then followed by an introduction of the mathematical content, examples of how to solve a task, a series of tasks and finally a summary of the chapter, as he described to the question "How did you structure the textbook?"

> "In developing the textbook in 2006, I divide it into some parts. There is introduction, examples, followed by guided exercise, and independent tasks. Probably some summary, and at the end of the chapters, it is important to give tasks to prepare students for the end-semester exams"

His experience of this pattern is that it is effective and easy to carry out in the classrooms. In selecting the tasks, he mentioned that he would start from a bare number problem then to contextual tasks, progressing from easy to difficult problems. He also mentioned that application problem would be given only after students have a strong mastery of the concepts, as he sees mathematics as the tool to solve a real-life problem, as suggested in the national curriculum. According to him, without adequate knowledge it is difficult for his students to solve the complex problems. He described this in regards to the question: Why did you put the contextual problems at the end of the chapters?

> "The principle is mathematics is a tool. A student can only solve a problem solving task when they know how to use the tool, the concept mastery. Therefore, problem solving should be given at the end, as suggested by the curriculum."

Although, he admitted that in the future he would like to have more tasks that requiring reasoning and higher order thinking in his textbook, not only routine and simple problems as there are now. He also emphasized the importance of providing examples and some general rules or summarization of how to solve a problem or task.

Familiarity with RME or PMRI

The textbook writer mentioned that he knows about PMRI and RME, as he had experience attending some lectures delivered by some RME experts, and was educated in the teacher education college where one of the PMRI centers is located. However, he had never participated in any PMRI training sessions or workshops. He has not had an opportunity yet to read the Dutch textbook or PMRI textbook, either. Personally, he admitted that he is more interested in learning about Singaporean mathematics education syatem than the Dutch. He also commented that contextual teaching and learning, or the realistic approach may not always be appropriate to teach mathematics, as he described when answering question: Are you interested in learning about Realistic Mathematics Education in the future?

> "At this moment, I learn more about Singaporean textbook. **Not that I don't want to learn about PMRI, but not all mathematics concepts can be contextualized**, introduced through contexts, many of them cannot."

From the above findings, it seems that the textbook writer was most concerned with the contents set by BSNP in developing the textbook. It also suggests that the textbook writer adopted traditional viewpoints in how mathematics learning should take place. That is from concept mastery to application. This combination resulted in the BSE textbook providing rigorous examples and prevalent use of rules, as well as addressing concept mastery development before the application of mathematics. In the relation to the inconsistency between the textbook and RME ideas, the discrepancy may be attributed to the writer not being knowledgeable about RME. The fact that the author consulted the Singaporean textbook, rather than the Dutch textbook, also shows how culture influences mathematics education practice. Here, the textbook writer may have assumed the educational cultures and systems of Singapore and Indonesia are closer than Indonesia and the Netherlands. Thus, he might consider the textbooks from Singapore to be a more relevant reference. On the other hand, while he agreed with the idea of contextual teaching and learning (CTL) or realistic approach, he may have a superficial understanding of what the approach is and how to apply the approach in teaching materials. This is plausible as he himself has been immersed in the traditional method of teaching mathematics in his own education and work place.

Nonetheless, this textbook, and other similar textbooks, have been approved by the National Textbook Center. This implies that the textbook is regarded by the center as successfully addressing the curriculum expectations and can help the curriculum to achieve its designed goals. However, the curriculum is quite general, is heavy and inflexible with contents, and has a superficial understanding of what a humanistic approach to mathematics education is, these attributes have contributed to how the curriculum has been translated into the textbook.

5.5 Summary

This chapter has discussed the consistency between RME and the curriculum document and textbook in Indonesia and in the Netherlands. The findings in this chapter inform the following chapters on how the consistency or inconsistency found may influence teachers' beliefs and practice of RME in the respective context. As suggested by past studies, the curriculum and textbook are among the most influential factors to teacher's instructional practice. For example, Dutch teachers might have advantages from the availability of the textbooks that have been developed based on RME and from the absence of centralized decision making on the contents to be covered. On the other hand, the effort of Indonesian teachers to implement the ideal RME-based lessons might be limited by the heavy curriculum content and the textbooks that have not fully adopted the RME ideas.

Chapter 6 – Teachers' Attitudes towards RME

This chapter presents the analysis of the survey that investigated the PMRI teachers' attitudes towards teaching and learning mathematics and whether they are consistent with RME ideas. This chapter discusses the procedures of the survey and the characteristics of participants who responded to the questionnaire (section 6.1), as well as the result of some statistical analyses (section 6.2). As a point of reference, the findings were compared to some results from the AVRR survey that had been administered earlier in the Netherlands (section 6.3), as presented in Verbruggen, et al. (2007), Frickel (2006) and Verbruggen (2006).

6.1 Procedures of the Survey

Based on a recent report from the PMRI team (Hadi, 2012), nearly one thousand teachers have been trained by PMRI local teams located in more than 15 provinces all over the country, with some of them serving as the 'key teachers' (*Guru Inti*). In the present study, the survey was administered in 12 big cities across 11 provinces in Indonesia where PMRI local centers are located, during November 2015 to January 2016. These included Padang (West Sumatra), Palembang (South Sumatra), Greater Jakarta (Capital City of Jakarta), Bandung (West Java), Semarang (Central Java), Yogyakarta (Special Administrative Region of Yogyakarta), Surabaya (East Java), Malang (East Java), Banjarmasin (South Kalimantan/Borneo), Makassar (South Sulawesi/Celebes), Singaraja (Bali) and Kupang (East Nusa Tenggara). A PMRI local center is a center for the research and development of PMRI under a teacher education college or university. In conducting their activities, the PMRI development institute at National level, known as IP-PMRI (*Institut Pengembangan* PMRI), monitors and supports the activities of the centers.

In this survey, we contacted the PMRI teams in each city, except for Jakarta and Bandung in which the researcher administered the survey by herself. The PMRI teams then helped researcher to identify PMRI schools in their locale, which was often listed in the websites of the PMRI center. These schools are often called '*Sekolah Mitra*' or 'partner' schools or simply PMRI schools, and some of their teachers are known as PMRI teachers, or '*Guru Mitra*', or '*Guru Inti*', who have been trained by the PMRI teams in a number of local and national workshops. The schools were also among the pilot schools during the initial development of PMRI. In each city, the number of PMRI schools varies, from two to ten schools, and the number of PMRI teacher ranges from two to twelve teachers, or an average five teachers, in each school.

With these lists, we contacted the principals of the PMRI schools to get their consents to allow their teachers to participate in the survey. In total, this study identified 62 active PMRI schools in the 12 sampled cities (out of 78 PMRI schools in total, listed on the websites of the PMRI local teams in each respective city). However, after making contact, only 50 schools agreed to participate, with a total number of 220 teachers. The other 12 schools were not participating due to some bureaucratic problems. This limitation should be considered in the discussion that follows.

Within three to five working days after the respective schools received the questionnaires, the PMRI team representative collected the completed questionnaires. They, then, sent them to the researcher's address in Jakarta. In total, this study received 202 completed responses, and the response rate was 92% (202 out of 220). The characteristics of the participants who responded to the questionnaires are summarized in table 6.1 below:

Of the 202 teachers who participated in the study, 170 or 84% are female and 32, or 16%, are male. The fact that the majority of participants are female is expected, as nearly 70-80% of primary school teachers in Indonesia are female (Satu Data Indonesia, 2012). Forty-eight percent of the teachers in this study taught lower grades (grade 1-3), and 52% taught upper grades (grade 4-6), with ten percent having a degree in mathematics/mathematics education and 41 % have a degree in primary school teacher education. Other qualifications recorded include degrees in education other than mathematics education or primary teacher education (language or art education). Sixty percent of these teachers were trained or involved in PMRI-related activities before the new curriculum implementation in 2006 (in the piloting and preparation phase of PMRI), with an average of teaching experience of 16.79 years (SD = 9.36) and average experience teaching with PMRI is 7.93 years (SD = 3.73).

Profiles	**Percentages**
Female	84%
Male	16%
Teaching Lower Grades	48%
Teaching Upper Grades	52%
Math/Math Education	10%
Primary School Teacher Education	41%
Others	49%
Trained in PMRI Activity before 2006	60%
Trained in PMRI Activity after 2006	40%

Table 6.1 Respondent profiles in the survey

6.2 Results and Analysis of the Survey Results

The 202 completed responses were analyzed quantitatively in which the exploratory factor analysis was conducted on the 48 items, each with a five points Likert scale. The aim of this analysis is to identify the underlying relationships between the measured variables. From the result of a factor analysis, four factors were extracted and labeled as Teacher Intention of Realistic Education (ITN), Guidance (GDN), Students' Self Development (SDM), and Interactivity (INT). This result is different from what was found in the AVRR study, which extracted only three factors. This will be cross referenced in the section 6.3. In this section, the result of the factor analysis and statistics summary of the four factors will be presented.

6.2.1 Factor Analysis and Interpretation

As the data is normally distributed, maximum likelihood was chosen as the extraction method with an oblique rotation method, which allows factors to be correlated. The pattern matrix from the factor analysis is shown in table 6.2. From the results, it can be seen that there are four factors extracted from the data:

1. Teacher Intention of Realistic Education (ITN)

   Eighteen items corresponded with the first factor. The items corresponded to the teacher's intentions to provide exploration activities, to use more contextual problems and to have a more process-oriented learning. Sample items in this factor are *'I hold up the principles of Realistic Mathematics Education'; 'I want to incorporate all principles of realistic mathematics in my lessons';* and, *'I think it's important for my students to explore math problems by themselves*'.

2. Guidance(GDN)

   For factor two, there are 12 items associated with teachers' viewpoints on how much guidance should be given to students. Sample items include '*I want my students to keep strictly to the topic of mathematics'; 'I want my students solve math problems using a standard method'; and 'I want my students to solve problems as much as possible at formal level'.*

Items No.	Pattern Matrix[a]				
	Factor				
	ITN	GDN	SDM	INT	h^2
41	**.743**	.108	-.076	-.020	.644
45	**.705**	.069	.052	-.016	.641
43	**.698**	.123	-.050	-.135	.625
13	**.608**	.050	-.043	-.134	.474
19	**.592**	.139	-.063	.073	.579
12	**.570**	-.015	-.002	-.180	.565
44	**.523**	-.142	.259	.165	.640
21	**.512**	-.116	.151	.045	.509
17	**.486**	-.062	.213	.039	.459
10	**.484**	-.183	.167	-.042	.509
07	**.464**	-.224	.157	.251	.552
11	**.454**	-.288	.086	.188	.473
48	**.439**	.018	-.065	-.093	.409
28	**.439**	-.093	.062	.071	.518
36	**.414**	-.038	.309	-.081	.563
05	**.408**	-.122	.231	.111	.481
46	**.340**	.304	.209	-.078	.415
01	**.247**	.052	.146	.006	.336
06	.146	**.621**	-.111	.227	.683
37	-.012	**.605**	-.113	-.089	.502
03	.018	**.549**	-.011	-.077	.441
29	-.034	**.540**	.008	.014	.485
24	-.019	**.536**	-.030	.307	.619
30	.154	**.461**	.059	.124	.403
32	.076	**.435**	.059	-.055	.415
33	-.067	**.430**	.051	.125	.434
42	-.183	**.408**	.234	.198	.482
26	.029	**.387**	-.111	.335	.574
23	-.142	**.368**	.040	.098	.382
31	-.055	**.304**	-.026	.238	.527
14	.032	.063	**.644**	.028	.556
02	-.056	.053	**.619**	-.198	.455
34	-.141	.034	**.618**	-.262	.524
09	.101	-.164	**.591**	.094	.498
40	.154	-.107	**.589**	.011	.574
35	.151	.087	**.525**	-.062	.567
27	.274	-.037	**.486**	.119	.572
39	.184	-.056	**.469**	-.103	.537
25	.041	.022	**.417**	.008	.488
38	.219	.083	**.369**	-.176	.453
08	-.215	.089	**.346**	.272	.426
18	-.065	.005	-.046	**.642**	.517
20	.085	.031	-.258	**.565**	.482
16	-.161	.134	-.067	**.541**	.566
04	-.008	.072	-.142	**.532**	.562
47	.165	.186	.001	**.471**	.520
15	-.096	.361	.102	**.377**	.606
22	-.224	.160	.077	**.372**	.487
Eigen value	8.963	5.305	2.794	2.118	
Variance	18.672	11.053	5.822	4.413	

Table 6.2 Pattern matrix of the survey results

3. Students' Self Development (SDM)

For the third factor, there are 11 items that are associated with the teachers' viewpoints on the opportunity shall be given for students to gain their personal knowledge and to develop their strategies in problem solving. Sample items are, *'I think my students can come up with their own solution strategies'* and *'I think my students can do flexible calculation'*.

4. Interactivity (INT)

In the fourth factor, Interactivity (INT), the items are associated with how teachers see the students' role in classroom discussions and how student-teacher interaction should be conducted. There are seven items included, and sample items are *'I think my students distract each other during an interactive lesson'; I think my students do not learn much by explaining their answers to each other*'; and, *'I think my students can only see the relationships between problems if I explain them clearly'*.

Some of the factors were also significantly correlated with one another (correlation coefficient > 0.3). For example, Teacher Intention (ITN) has a positive correlation with Students' Self Development (SDM), with r = 0.361. The Guidance (GDN) factor is positively correlated with Interactivity (INT), with r = 0.316. The positive correlation between ITN and SDM means the higher the commitment of teacher towards the use of RME in their classroom, the higher their commitment to providing more opportunity for their students to learn within the RME environment. The positive correlation between GDN and INT means that the higher the teacher's commitment to providing appropriate guidance consistent with RME ideas, the higher their commitment is to enact the idea of interactive education. The correlation shows that the four factors might not be independent and are actually related to each other. The reliability of the overall questionnaire and of each factor was also examined and showed satisfactory results (Cronbach Alpha > 0.7). Overall, the Cronbach Alpha is 0.827, while for each factor is 0.882 for ITN (18 items), 0.819 for GDN (12 items), 0.809 for SDM (11 items), and 0.756 for INT (7 items) respectively.

6.2.2 Teachers' Attitudinal Scores

The completed responses from the 202 participants on the 48 items were analyzed. In the five-point Likert scale, the items which got high scores (4-5) are considered as associated with positive attitude towards RME, while low scores (1-2) show the reverse with RME principles. A score of three indicates a neutral viewpoint. As can be seen in table 6.3 below, the GDN and INT factors mostly have items with negative valence. Thus, the score of the items will be reversed.

Factors	Items
ITN	1, 5, 7, 10, 11, 12, 13, 17, 19, 21, 28, 36, 41, 43, 44, 45, 46, 48
GDN	3*, 6*, 23*, 24*, 26*, 29*, 30*, 31*, 32*, 33*, 37*, 42*
SDM	2 ,4, 8*, 9, 14, 25, 27, 35, 38, 39, 40
INT	15*16*, 18*, 20*, 22*, 34*,47*

*This item has negative valence

Table 6.3 Distribution of items over the four factors

From the result, the mean score shows that of the PMRI teachers who participated in this survey, most, show beliefs of teaching and learning mathematics that are consistent with RME (M = 3.67). Particularly, their intention towards the use of RME in the lessons has the highest mean score among other factors (M = 4.25), while factor 2, GDN, has the lowest mean score (M = 2.96). For the other two factors, SDM and INT, they have mean scores of 3.56 and 3.26 respectively. The details of the descriptive summary of each factor are presented in table 6.4 below:

Factor	Mean	SD	Min	Max
Overall	3.67	0.31	2.98	4.42
ITN	4.25	0.35	3.33	5.00
GDN	2.96	0.57	1.33	4.58
SDM	3.56	0.41	2.09	4.82
INT	3.26	0.57	1.29	4.43

Table 6.4 Attitudinal score of overall survey and of each factor

Of the 202 completed responses, there are four participants who have an overall mean score below 3.00, 58 participants who have a mean score between 3.00 and 3.50, 111 participants who have mean score between 3.50 and 4.00 and 29 participants who have a high mean score above 4.00. The mean scores for each group in each factor are presented in table 6.5 below:

Attitude Group	N	Overall	ITN	GDN	SDM	INT
(< 3.00)	4	2.97 (0.00)	3.69(0.41)	2.42(0.16)	2.84 (0.63)	2.29(0.28)
(3.00 – 3.50)	58	3.34 (0.11)	3.99(0.25)	2.55(0.46)	3.50(0.39)	2.78(0.48)
(3.50 – 4.00)	111	3.73 (0.13)	4.29(0.27)	3.01(0.44)	3.81 (0.28)	3.38(0.42)
(>4.00)	29	4.21 (0.12)	4.70(0.19)	3.65(0.45)	4.25(0.21)	3.83(0.46)

Table 6.5 Attitudinal score for each attitude group

As can be seen in table 6.5, in most attitude groups, the teachers have the highest mean scores in ITN, followed by SDM, INT and GDN, respectively. For various group of teacher, some statistical analyses were also conducted. The analyses mainly aimed to investigate whether the teacher backgrounds have significant effects on their attitudes towards RME in general, and in each factor, in particular. These included an analysis of the teacher's attitudes towards each factor for different sexes, grades (lower – upper grades), teaching experience (below or above 10 years), and years of experience teaching RME (below or above 10 years). The mean and standard deviation of the overall score and score in each factor for different background profile is also shown in table 6.6.

Profile	**Overall**	**ITN**	**GDN**	**SDM**	**INT**
Male	3.66 (.309)	4.34 (.404)	2.95 (.626)	3.79 (.389)	3.15 (.605)
Female	3.69 (.338)	4.23 (.336)	2.95 (.554)	3.75 (.416)	3.27 (.562)
Teach Lower Grade	3.72 (.338)	4.32 (.363)	2.98 (.646)	3.80 (.421)	3.32 (.609)
Teach Upper Grade	3.62 (.280)	4.18 (.324)	2.92 (.480)	3.73 (.400)	3.19 (.526)
<10 years TE	3.60 (.243)	4.18 (.323)	2.90 (.462)	3.65 (.357)	3.22 (.517)
>10 years TE	3.70 (.337)	4.28 (.358)	2.97 (.608)	3.81 (.426)	3.27 (.517)
<10 years TE w/ RME	3.58 (.259)	4.19 (.323)	2.81 (.518)	3.70 (.370)	3.14 (.541)
>10 years TE w/ RME	3.80 (.259)	4.33 (.373)	3.16 (.571)	3.85 (.454)	3.43 (.570)

*TE : Teaching Experience

Table 6.6 Attitudinal score of teachers with different background profile

The results of multivariate analysis (MANOVA) showed that there are no significant differences in terms of teacher attitudes towards RME between male and female teacher ($F = 1.442$; $p = 0.211$; $eta^2 = 0.035$), or between teachers with different teaching experiences ($F = 1.422$; $p = 0.218$; $eta^2 = 0.035$). The differences, however, were found significant for teachers who teach different grades ($F = 2.540$; $p = 0.030$; $eta^2 = 0.061$), and have different years of teaching experiences with RME ($F = 5.567$; $p = 0.000$; $eta^2 = 0.124$).

The lower grade teachers have higher intention use of RME in their classrooms than those who teach upper grades. This can be understood that the teachers in lower grades might find RME to be more relevant to their teaching than those who teach upper grades. Furthermore, the textbook as well as the curriculum documents place less emphasis on RME approaches in higher grades compared to the lower grades. Teachers who have more teaching experience with RME also show more support towards RME than those who have less teaching experience with RME.

6.3 AVRR survey: A Point of Reference

As mentioned above, the questionnaire utilized in this study was originally developed by Verbruggen et al. (2007). As the present and the AVRR study, have similar purposes, the results of the two studies also allow us to do some comparison. However, as the AVRR survey was conducted in 2004 while the PMRI survey in the present study was conducted in 2015, and the reliability of the translated questionnaire is slightly lower than that in the original language, the results of the two studies, especially when it is compared one to another, should be carefully interpreted. Despite the above points, some interesting points still arise from the results of the two studies, as presented below.

AVRR Survey		**PMRI Survey**	
Factors	**Items**	**Factors**	**Items**
Teacher Intention (*Leerkrachtintenties*)	1,5,7,10,11,12,13, 17,19,21, 25, 26*, 27, 28,35,36,41, 43,44,45, 46,48	ITN	1, 5, 7, 10, 11, 12, 13, 17, 19, 21, 28, 36, 41, 43, 44, 45, 46, 48
Lesson Structure (*Lessenstructuur*)	3*,6*,15*,24*, 29*, 30*, 32*,33*, 37*,42*, 47*	GDN	3*, 6*,23*, 24*, 26*, 29*, 30*, 31*, 32*, 33*, 37*, 42*
Student Opportunity (*Leerlingmogelijkheden*)	2,4,8*,9, 14, 16*,18*,20*,22*,23*, 31*,34*,38, 39,40	SDM	2 ,4, 8*, 9, 14, 25, 27, 35, 38, 39, 40
		INT	15*,16*,18*, 20*, 22*,34* , 47*

*The item has negative valence and has been mirrored

Table 6.7 Distribution of items in AVRR and PMRI survey

Using the same instrument, the data sets in the two studies extracted a different number of factors. There were three factors extracted from the Dutch data, Teacher Intention (22 items), Lesson Structure (11 items), and Student Opportunity (15 items). In the Indonesian data, there were four factors identified, instead. These include Teacher Intention (ITN), Guidance (GDN), Students' Self-Development (SDM), and Interactivity (INT). It can be seen in table 6.7 that all items within the first factor in the present study were actually apparent in the first factor of the Dutch study. However, in the present study, some items (e.g. item 25: "I think the content of my math class should be tailored to the interests of my students", and item 27: "I think that reflection on their solution method will raise students' level of understanding") are identified in SDM (students' self-development) factor, instead. The second factor in the present study, GDN (guidance), shared many common items with the 'Lesson Structure' factor of the AVRR study. On the other hand, item 15 ("Ideally, my students learn the most from me during mathematics lesson") and item 47 ("I think my students can only see the relationships between problems if I explain them clearly") in 'Lesson Structure' are identified in INT (interactivity). As for the third factor in the present study, the items were mostly similar to the 'Student Opportunity' in the AVRR study. Yet, some items (e.g. item 16: "I think my students do not learn much by explaining their answers to each other", item 18: "I think it is difficult for my students to articulate their own solutions", and item 20: "I think my students distract each other during an interactive lesson") are structured into INT (interactivity), and some others (e.g. item 23:" I think my students will not come up with their own solution methods") are structured into GDN (guidance).

That a different number of factors were extracted from the two data sets actually show how the teachers from the two places may have different concerns on what is regarded to be RME. In the Dutch data, the teachers' responses form a pattern associated with three groups of items in which each group is related to the factor that best describes it: Teacher Intention, Lesson

Structure, and Student Opportunity. For the same items, the PMRI teachers tended to respond differently. Their responses showed patterns to factors best described as Teacher Intention, Guidance, Student's Self-Development and Interactivity. The mean scores for each factor in the two studies are presented in table 6.8 below:

AVRR (N = 440)			**PMRI (N = 203)**		
Factor	**Mean**	**SD**	**Factor**	**Mean**	**SD**
Overall	3.64	0.53	Overall	3.67	0.31
Teacher Intention (*Leerkrachtintenties*)	4.10	0.54	Teacher Intention	4.25	0.35
Lesson Structure (*Lessenstructuur*)	3.24	0.67	Guidance	2.96	0.57
Student Opportunity (*Leerlingmogelijkheden*)	3.25	0.74	Self-Development	3.56	0.41
			Interactivity	3.26	0.57

Table 6.8 Attitudinal score in AVRR and PMRI survey

The mean scores for the overall attitudes towards RME in the two studies are very close, 'M = 3.67' in the Indonesian study and 'M = 3.64' in the AVRR study. A substantial difference is particularly noticeable in the second factor of the two studies, which shared many common items. Here, the mean score for the Indonesian teachers was substantialy lower than their Dutch counterparts. As aforementioned, within Guidance, the items were associated with a teacher intention to use the standard method, to put a high value on the right answer, to provide tasks in a more formal style, and to direct the lesson strictly. For the items in interactivity, it can be generally differentiated into vertical interaction and horizontal interaction. For the latter in particular, the mean differences of the items in the two studies were also found to be noticeable as shown at table 6.9 below:

Items	AVRR Survey		PMRI Survey	
	Mean	SD	Mean	SD
Item 16: I think my students do not learn much by explaining their answers to each other.	**4.17**	**1.17**	3.04	0.82
Item 20: I think my students distract each other during an interactive lesson.	**3.45**	**1.24**	3.01	0.88
Item 22: I think that it is too much to ask students to cooperate during the mathematics lesson.	3.37	2.21	**3.73**	**0.86**

Table 6.9 Mean score of 'horizontal interaction' items in AVRR and PMRI survey

From table 6.9, it can be seen that the Indonesian teachers tend to have a lower intention than their Dutch counterparts on their expectation of student-student interaction. Here, teachers may have different expectation of how interactivity between students should take place. Interestingly, they tend to have a higher intention to provide opportunity for students to cooperate with their peers than the Dutch teachers do (item 22).

6.4 Discussion

There were four factors extracted from the data in this survey. These factors were labeled as teacher intention towards Realistic education (ITN), Guidance provided for the students (GDN), Opportunity given for students Self Development (SDM), and Interactivity in the classrooms (INT). In general, the PMRI teachers participated in this study showed supports towards RME, which is consistent with the findings of past PMRI studies which reported positive attitudes towards the approach from PMRI teachers (Hadi, 2012; De Haan, et al., 2010; Turmudi, 2012). Comparing this result and that of other studies on Indonesian teachers' beliefs conducted about two decades ago (Margono, 1996) also inform us that RME adaptation in this country has brought a new insight to Indonesian mathematics education in which the teachers' perspective may now be slightly shifted from the traditional to a more constructivist approach, such as RME. However, the beliefs upheld by the teachers can be regarded as ‘mixed’ beliefs rather than inclined towards one end in the continuum. This ‘mixed’ viewpoint is evident in the teachers’ high disposition towards the realistic approach and opportunity for students to involve in active learning but low intention to give appropriate guidance and provide interactive education.

In an OECD study (OECD, 2009), namely TALIS (The Teaching and Learning International Survey), similar characteristic of ‘mixed’ beliefs was also observed. This study reported that teachers in some Asian and South American countries which had undergone curriculum reform in recent years (e.g. Malaysia and Brazil) were also found to uphold similar ‘mixed’ beliefs, rather than fully support the constructivist ideas as expected. They express support for the constructivist approach, which may be perceived as being fashionable and thus socially desirable, but at the same time also support a direct transmission view.

Furthermore, the fact that a different number of factors was extracted from the current dataset and the AVRR study data set shows that teachers in the two places may have different concerns on what RME is. Here, while the Dutch teachers only concerned about the teacher role, lesson structure and students’ learning as important elements of RME classroom, the PMRI teachers seem to have a particular concern on how guidance and interaction should take place in the classroom. This aspect was also found to be noticeably lower than that of their Dutch counterparts. There might be two possible explanations for this inconsistency. First, it might be that because RME has been developed for more than forty years in the Netherlands it has, consequently, been utilized in various sectors of mathematics education such as teacher education, curriculum development, and, most importantly, the classroom implementation. Whereas in Indonesia RME has only been adopted for about a decade, and is still in a developmental phase. According to this, the difference in attitudes between the teachers in the two places is because RME has not taken root in Indonesian education yet. Given time for RME to develop in Indonesia, their teachers will eventually espouse the same consistent viewpoint with RME theory, as their Dutch counterparts do.

Alternatively, the differences might be due to the different cultures between the countries under discussion as argued by similar studies (Liu and Feng, 2015; Ebaguin and Stephens, 2014), rather than on the developmental phases. For example, the particularly lower intention of the Indonesian teachers of their expectation for student-student interaction, compared to that of the Dutch teachers, might be explained by how the two cultures see the expression of opinion. The Indonesian culture, particularly Javanese, emphasizes harmonious relationships throughout society, and discourages aggression directed toward adults and peers (Koentjaraningrat, 1985; Geertz, 1961). It is not necessary for someone to explain his opinion verbally. Indonesian society aspires to a calm state of mind which can lead to wisdom. This strong emphasis on social harmony (*rukun*) has also characterized the typical Javanese person as avoiding social or personal conflict (Farver etal., 1997). In contrast, the Dutch culture, as in other Western cultures, often tolerates this aspect, justifying it as the need to stand firm for one's beliefs. As shown in chapter five, the Dutch curriculum emphasizes this aspect, as teachers are encouraged to nurture a classroom culture where students can criticize others, explain to each other and so on.

Moreover, Javanese societies also stress compliance and expect children to be very obedient. This may serve to explain why the Indonesian teachers, even the ones with a high intention to use RME, stress rule-following method much more than the Dutch teachers.

Furthermore, cultural factors may also serve to explain some consistencies between teachers' attitudes towards teaching and learning mathematics and RME ideas. The fact that the constructivist idea was often presented in the curriculum document and promoted through teacher development programs as the emphasis of the reform, the teachers' responses on these items might be greatly influenced by this strong rhetoric. Thus, in cases where the PMRI teachers reported supporting beliefs towards a constructivist view (such as RME) they may attempt to show compliance towards the curriculum description which suggests a more progressive way of teaching mathematics.

The consistency between Indonesian teachers' attitudes towards teaching and learning mathematics and RME actually point to the need for further study. To understand whether the belief they reported is strong, the present study conducted classroom observations, which are reported in chapter seven. Besides, the fact that teachers with more RME teaching experience and teaching lower grades were found to have a higher attitudinal score, the classroom study may also focus on these teachers to maximize the findings. Finally, the classroom study may be able to understand if the differences in terms of attitudes towards RME upheld by Indonesian and Dutch teachers are reflected at the classroom level. The consistency between teachers' beliefs presented in this chapter and their teaching practice will be discussed in chapter eight. The discussion also includes in-depth interviews with the observed teachers.

Chapter 7 – RME Implementation at the Classroom Level

As described in previous chapters, this study conducted classroom observations involving teachers in Jakarta and Utrecht who intended to enact RME ideas in their lessons. In this chapter, section 7.1 depicts the final version of the coding scheme utilized to analyze the lessons. Section 7.2 explains the characteristics of the observed teachers, while section 7.3 presents the analysis of lessons. Section 7.4 discusses how each principle of RME was enacted in the lessons, which is followed by a discussion in section 7.5.

7.1 The Final Version of the Coding Scheme

In chapter 4, a coding scheme by De Ridder and Vanwallaghem (2010) has been described and modified following the pilot study. The final version of the coding utilized in the main study is described below:

1) Lesson structure (percentage of time)

   In terms of lesson structure, the lesson events were categorized into one of the following sections: review, introduction, practice, repeat-automate, preparation and non-math related. During the 'practicing' session (where the students apply new procedures and practice new material), the teacher's involvement behavior was further coded into three sub-categories: helping individual students or groups, helping the whole class rather than individual students, or no contact (e.g. doing administration work).

2) Methods of Interaction (percentage of time)

   In terms of methods of interaction in the classroom, there are seven sub-categories examined. They are 'teacher teaching', 'teacher-whole class' interaction, 'teacher-individual student' interaction, 'individual student-teacher' interaction, 'student-student' interaction, 'students working individually', and 'students working together'.

3) The Occurrence of Lesson Events Related to RME

The coding also looked at the occurences of lesson events that particularly reflect the RME ideas. There were five events examined in this category: 'use of contextual problem', 'use of model and scheme', 'use of bare number problem', 'making connections', and 'working step by step'.

To ensure the reliability and the validity of the coding, the researcher and one of her Indonesian colleagues coded two Indonesian and two Dutch lessons. The Dutch lessons were transcribed in their original language, then were translated into *Bahasa* Indonesia for coding. The Indonesian lessons were transcribed in *Bahasa* Indonesia. As anticipated, there was differences in the start and stop times between observers in some classroom incidents, these were resolved via a joint coding and discussion until an agreement was reached.

7.2 The Characteristics of the Observed Teachers

The classrooms observations in Jakarta were conducted from January to February 2016. All teachers were female and taught grade one, all had more than ten years PMRI teaching experience. Similar observations in Utrecht took place from March to April 2016. One of the teachers was male. Two teachers teach grade one (*groep* three in Dutch school) and one teacher teaching a combination group of grade one and two (*groep* 3/4), which is common in the Dutch system. They all have been teaching using the Realistic approach (as identified from the textbook they used) for more than 10 years.

The three teachers in Jakarta are PMRI teachers who teach at PMRI schools, which have implemented PMRI since its first establishment in Jakarta. The teachers have been involved in the PMRI-related activities at the local and national level for more than ten years. Two schools were under the guidance of the State University of Jakarta (UNJ), and one school is under the guidance of Sanata Darma University, Yogyakarta. The three teachers in Utrecht were recommended by Freudenthal Institute, Utrecht University. In the Netherlands, the schools which intended to use a RME approach could be identified from the textbook they use. Here, two teachers used *Pluspunt*, while one teacher used *De Wereld in Getallen*. The PMRI teachers in Jakarta were also equiped with both the PMRI and BSE textbook discussed in chapter five.

The three teachers in Jakarta will be referred to as teacher JKT 1, teacher JKT 2, and teacher JKT 3. The three teachers in Utrecht will be referred to as teacher UTR 1, teacher UTR 2 (the combination class), and teacher UTR 3.

The three schools in Jakarta are all ‘A’ accredited, which means ‘excellent’ for national standard. Thus, the school facilities do not differ significantly from one to another, although variations in terms of seating arrangement and class size were apparent. The class size was 32, 20 and 43 for each classroom. In Jakarta, students in grade one learn mathematics twice a week in 45 to 60 minute lessons.

The three schools in Utrecht do not differ significantly from one another in terms of facilities, although they are quite different from the Jakarta schools. For example, Utrecht classrooms are equipped with new technology such as smart-boards that are linked to teaching resources like the electronic version of a textbook. All the concrete manipulatives from the textbooks are also available in the classrooms. The teachers’ and students’ work on the smart-board can also be digitally recorded. The class size in Utrecht classrooms was 28, 24, and 25. In Utrecht, students in grade one (and in the grade one and two combination class) learn mathematics in one, one-hour lesson each day. These differences in facilities and arrangement should also be considered in the analysis that follows.

7.3 Analysis of the Lessons

In this section, the analysis of lessons using the coding scheme described above is presented. For each teacher, four lessons were observed and videotaped. In total, there are 12 lessons analyzed for each place. All lessons in Jakarta covered the addition and subtraction topic, while the lesson in Utrecht covered various mathematical strands, including addition and subtraction, measurement of time, multiplication, currency, and number structures. The average duration of the lessons in Jakarta and Utrecht is 55 minutes and 50 minutes, respectively. The medium of instruction in the Jakarta classrooms is *Bahasa* Indonesia, and the medium of instruction in the Utrecht classrooms is Dutch.

7.3.1 Lesson Structure

A summary of the lesson structures in the observed classrooms is shown in figure 7.1. The figure shows that teachers in both places spent a significant amount of lesson time for ‘introduction’ and ‘practicing’. As presented earlier in chapter 4, ‘introduction’ involves all activities that introduce a new mathematical topic or content. The teacher presents and explores mathematical problems that have not been discussed previously. Activities may also include explaining the goals of learning the new content, giving examples, and introducing tasks. Before this session, teachers usually do some preparation. Preparation includes all activities during the start of a lesson, or activities to prepare students to get ready for learning such as distributing worksheets or writing on the board. Following the introduction activities, teachers normally provide tasks for students to complete. This was coded as ‘practicing’. It encompasses all activities that involve students applying and practicing the topic or material they have learned, or completing tasks that have been introduced. Moreover, some teachers had some ‘repeat-automate’ activities in their lessons. This includes all activities that involve tasks that assume everyone has already acquired the curriculum, and/or mastering the subject matter in relation to a full understanding by everyone. The activities may include giving additional tasks after practicing, or repeating the tasks that have been previously practiced.

However, lessons in Jakarta spent most of the lesson time to introduce the lesson or the content (37.14%), while the lesson time in Utrecht was mostly allocated for practice sessions (51.50%). The teachers in Utrecht also spent more lesson time reviewing previous lessons and materials (9.23%) than their counterparts in Jakarta (3.10%). On the other hand, the lessons in Jakarta allocated more time for preparation, repeat-automate, and non-math related activities than in Utrecht.

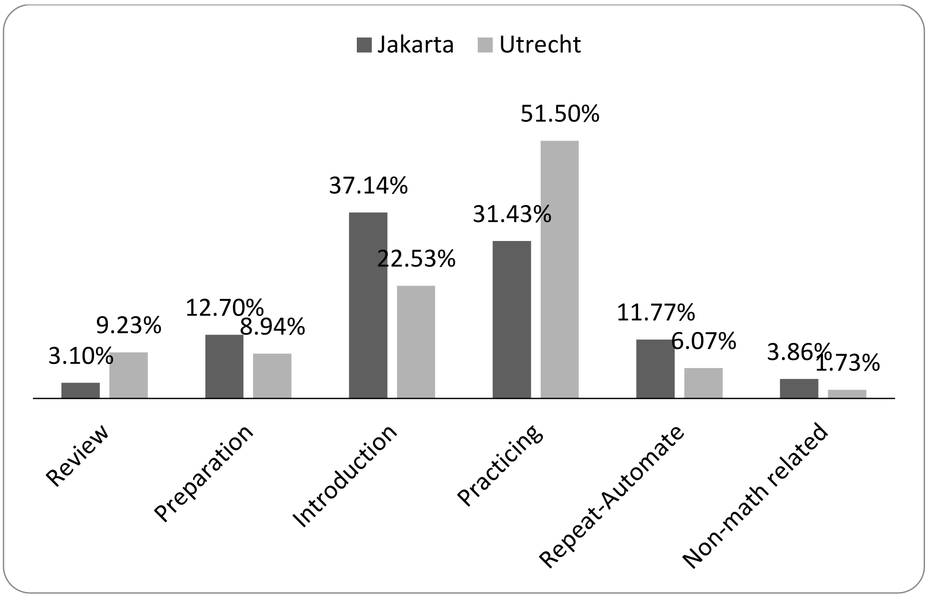


Figure 7.1 Lesson structure in Jakarta and Utrecht classrooms

In the Utrecht classrooms, teachers normally began the lessons by reviewing the previous lesson or by discussing a contextual problem. This was usually followed by giving instructions on what students will do for the rest of the lesson, whether they do individual or group work. In one of the classrooms, the lesson was conducted differently. It was usually began in a small circle in front of the board to discuss the topic they are going to learn. After this activity, students might go back to their own tables to do individual or group work, while the teacher walked around the class to see how students are doing. In the final section of the lesson, the teacher invited students to go back to the circle where the lesson began, to discuss the tasks they had solved. During this session, students are required to explain their strategies in getting their answer, and are asked to compare theirs with others, or to comment on others' opinion. In the combination class (of grade one and two), a different practice was observed. The teacher was found to have a discussion during the review or introduction sections.

In Jakarta, the teachers normally started the lesson by introducing a new topic, which was then followed by giving tasks for students to practice. In introducing the topic, teachers usually provided students with sample problems and the detailed steps on how to solve the problems. Thus the tasks given were mostly very similar to the sample problems given during introduction.

While the teachers in the two places were found to allocate a significant amount of time for students to work on mathematical tasks, the practices were quite different. During 'practice', students in Utrecht did the individual tasks from the workbook. In the class that used *De Wereld in Getallen* for example, there are three levels of tasks for students with different abilities. Moreover, the high achievers were supplemented with *Reken Tijger*, which contains more problem solving and high-order thinking tasks, or with *Pluspunters* in the class that used *Pluspunt*. On the other hand, the low achievers will do a more concrete and simple tasks, and assissted more by the teachers. Some students were also allowed to do computer tasks, or play some games in the corridor, as long as it is related to mathematics. In Jakarta, on the other hand, during the individual work, the teachers only provided one set of tasks for all students, and offered no differentiation in terms of tasks given to students with different abilities. Teachers usually wrote down a set of questions on the board, or distributed worksheets for the students to work on. At the end of each lesson, sometimes the teacher asked some students to write their answer on the board.

Moreover, the teachers in the two places also showed different involvement behavior during practice session as shown in figure 7.2:

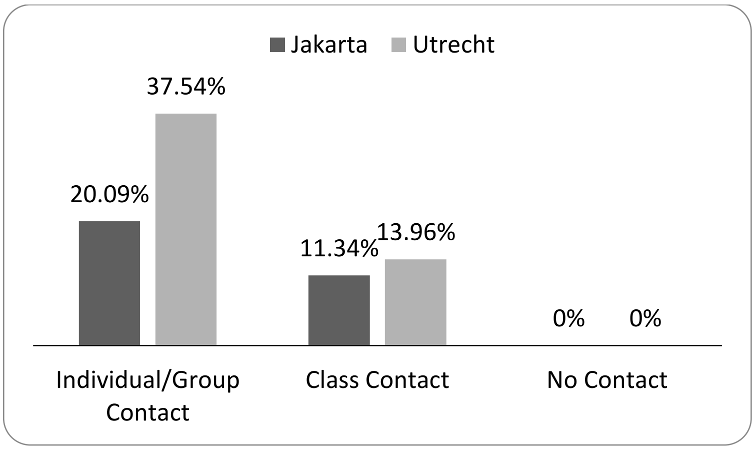


Figure 7.2 Teacher involvement during 'practicing' activity in Jakarta and Utrecht classrooms

While teachers in the two places spent a relatively similar amount of time helping students solve the tasks in a whole class session, the Dutch teachers were found to spend a significantly higher proportion of their lesson time in individual or group consultation (37.54% of the whole lesson time), compared to their Indonesian counterparts (20.09% of the whole lesson time). This can be understood as students in Utrecht classrooms were often placed sitting with someone who has a similar level of scholastic ability to them in a 'special' table. Thus, it is easier for the teacher to give assistance to similar types of students. During contact with the individual or group of students, surprisingly, it was observed that teachers in Jakarta often checked whether students' answers are correct, and then marking their work at the same time.

During the class contact, different practices were also observed in the two places. In Jakarta, the teacher often simply asked students to read aloud their answer, or write down their answer on the board. Presented below is an example of a teacher response when an individual student wrote his answer on the board:

[Lesson 3, JKT 1]

Teacher [T], Ss [Students]

T	: OK. Who have finished doing the task? Raise your hand. Now, look at the board. But, before I do this for you, does anyone would like to help me? (A Student wrote his answer on the board)
T	: Good job. Look at his work. Do you think it is a correct answer?
All Ss	: Yes…
T	: 100 Points for you. Give applause. Who has similar answer with him?
Some Ss	: Me… Me…
T	: OK, if you get it wrong, please copy it. One minute.

The excerpt shows that teacher JKT 1 did not ask the individual student to explain how he got the answer. Instead, the teacher asked students to simply write down the answer, and then asked others to check whether it is correct or not. Moreover, the teacher also preferred her students to copy the correct answer. During individual work, it is also common for the teacher to encourage students by giving reward points and applause.

In Utrecht, on the other hand, when discussing the problem with the whole class, teachers often required students to explain their strategies used to solve the problem, as shown in the excerpt below:

[Lesson 1, UTR 2]

T	: OK. Last time we have discussed about ‘number line’ up to 100. If you have to add ‘35 + 26’ (*write down on the board*), how would you solve and represent it on a number line?
S1	: You can start with put thirty-five on the number line and then add twenty, equal to fifty-five and then add five more equal to sixty, and then one more, equal to sixty-one
T	: Alright, good. Does anyone have different ideas (*on how to find the answer*)?

As shown above, the teacher in Utrecht liked the students to explain their strategies used to find the answer, rather than only giving their answer. In Jakarta, some teachers actually attempted to encourage students to show their strategies; however, as students did not show the expected responses, teachers often ended up explaining the strategy for the student. Below is an example from one of the lessons:

[Lesson 3, JKT 1]
Teachers gave problem of “48 + 26” for students to be solved. She then asked some students to come forward to demonstrate how to add 48 straws to 26 straws. They then come to a conclusion that the answer was 74.

T	: Do you know how to get seventy-four? Does anyone can explain?
All Ss	: Silent

(Teacher asked the same questions for several times but the class remained in silence)

T	: OK. I will tell you. Listen. How many tens do I have? (*Show 6 bundles of straws*) Sixty, right? How many ones? Fourteen. For the fourteen, we have one ten and four. (*She counts the fourteen straws and took ten of them*). Now we have ten, and let’s tie them up and give it to our friends who owned the tens. So, how many tens do we have for now? Count!

S1 : (*One student who hold the straws in front of the class, count the straws on together with his other friends*) Ten, twenty, thirty, forty, fifty, sixty, seventy…
T : How many left?
All Ss : Four
T : How many altogether?
All Ss : Seventy-Four
T : OK. When I asked how you get the seventy-four that was the way to get it.

The excerpt above shows that the teacher actually tried to begin a discussion on the strategy used to get the answer. However, at the end, the teacher dominated the discussion, and the students only gave tentative and short responses. There was a lot of choiring in the classrooms.

7.3.2 Methods of Interaction

In terms of methods of interaction, the analysis of the lessons have been summarized in figure 7.3 below.

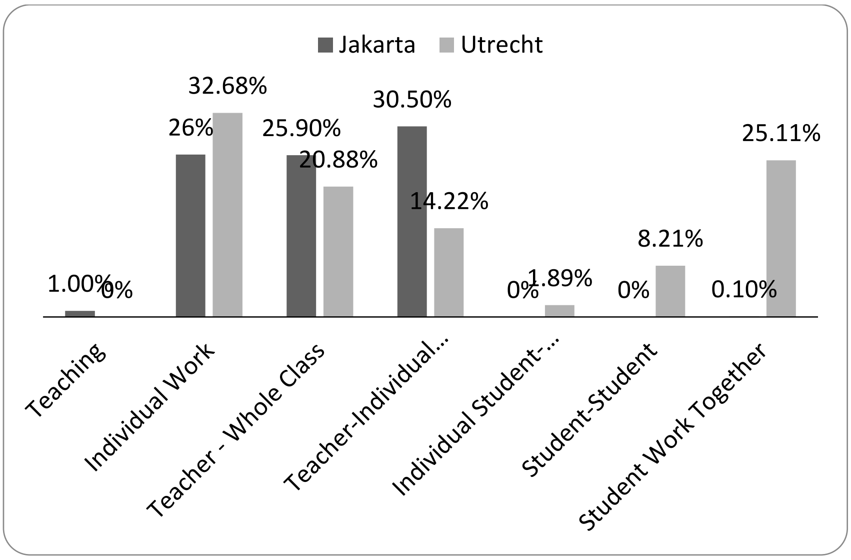


Figure 7.3 Methods of interactions in Jakarta and Utrecht classrooms

According to the figure, the teachers in the two places spent significant lesson time for whole class interaction (25.90% and 20.88%), and insignificant lessons time for the teacher teaching mathematical content (chalk and talk). In Jakarta, ‘teacher-individual’ interaction (30.5%) was also dominant. Yet, the lessons did not allocate a significant amount of time for student interaction, or students working in group (if any, it was less than 1% of the total lesson time). In Utrecht classrooms, a wider range of interaction methods involving vertical and horizontal interaction was observed. The vertical interaction included teacher-whole class interaction (20.88%), teacher-individual student (14.22%), and individual student-teacher interaction (1.89%). The horizontal interaction includes students working in small groups or in pairs (25.11%), and student-student interaction (8.21%).

In regard to the ‘individual student-teacher’ interaction, although infrequent (1.89%), some students in Utrecht were found to take the initiative to start a discussion by asking questions to the teacher. In Jakarta, this form of interaction was absent. An example of individual student -teacher interaction is shown in the excerpt below:

[Lesson 2, UTR 1]

Teacher [T] asked students to solve ‘ 7 + … = 10’. One of the students [S] raised his hand, asked if this was a problem of ‘making a 10’ strategy for addition.

S1 : Sir, seven and three, they belong together, right?

T : Belong together? Did I say it? Yes. And, you remember them. And do you hear even more numbers that belong together?

S1 : Eight and two, nine and one, ten and zero

T : Incredible. Even more?

S1 : six and four, five and five

T : It sounds like music to my ears. Thank you.

In the above excerpt, the student tried to recall his previous knowledge to solve the given problem. His initiative to ask the teacher a question was then used by the teacher to generate other numbers that would make ‘a friend of 10’.

Another form of interaction observed in Utrecht classrooms, but was missing in the Jakarta classrooms, was student-student interaction. Below is an example of a classroom episode where teachers tried to establish student-student interaction. It is noted that during this ‘student-student’ interaction, teachers may still be involved to clarify the answers so it can be understood by others.

[Lesson 4, UTR 1]

T	: I have some addition problem. How do you calculate what is here (on the board) at the blanks? I do not know the answer, and I want to know how do you get your answer. Then let's have a look at this sum. ‘11 + ... = 20’. Now we saw yesterday; ‘1 + ... = 10’. How would you calculate it? Tell it to the whole class.
S1	: [*stand up*] You have ten and if you add ten again you will have twenty.
T	: So you have ten and ten makes twenty?
S1	: And then you already have one, then you know it's nine.
T	: So he starts from ten. Then, add ten more, there is twenty. Then, he says it is just one difference and I know it is nine; because eleven is only one difference from ten. Others, how would you calculate it? How do you calculate what this should be placed at the blanks? And I ask everyone, everyone should think about it. Would you do the same as his?
S2	: [*stand up*] No, I have a different way. You have eleven and you can add a four.
T	: OK, eleven and four (*wrote on the board 11 + 4*)
S2	: And, you can add another five
T	: Do you mean fifteen plus five is twenty (*wrote on the board* ‘15 + 5 = 20’) and then we are in there? And how do you know what should be on the blanks?
S2	: It is nine
T	: How do you know?
S2	: First you have four, then five, and that is nine.

T : How about others? Do you calculate it differently?

S3 : I would just use my fingers. You start at eleven and stops at twenty. I count like twelve, thirteen… twenty and I see nine fingers (*show her fingers*)

T : OK. Thank you. (*He re-explained the student answer to the whole class*)

From the excerpts, it can also be seen that students compared their strategies with one another. While one may see the problem as a closed question which requires only a single short response, the students in this class reflected upon different strategies they had to solve the problem. In the perspective of students' reflection, this kind of discussion can facilitate individual student thought process, as well as that of others.

In one of the lessons in Jakarta, a teacher actually attempted to give an opportunity for students to share their ideas to their peers. However, she ended up taking over the discussion too fast. Thus, the episode eventually fell under the 'teacher-whole class' interaction, or 'teacher-individual student' interaction styles, rather than under 'student-student' interaction. Following is an example of the situation:

[Lesson 4, JKT 3]

Teacher asked one of the students to do the task on the board "15 + 18" and show others on how to solve it.

T :Yes, one ten plus five ones. Then, add eighteen more.
(Teacher had concrete teaching aids that she called as 'box of tens' and 'box of ones'. She asked the student to put one bundle of straws to the 'box of tens' and five straws to the 'box of ones'; and, similarly for 18.)
Now, what do you have to do? There are more than 10 straws in the 'box of ones, isn't it?
(The student tied up 10 out of the 13 straws she had in 'box of

	ones' and move them into the 'box of ten')
S	:Thirty three
T	:Thirty three, show us the steps *(Student draw 33 straws on the board and then number 33)* OK, let's see what she was doing. Fifteen, how many tens?
All Ss	:One
T	:And how many ones?
All Ss	:Five
T	:Then, eighteen, how many tens?
All Ss	:One
T	:How many ones?
All Ss	:Eight
T	:OK, let's do it together again. One, two... eight (*take the eight straws and count them*) Then, what is next?
Some Ss	:Tie them up
T	:Pay attention, please. Now, we count how many ones in total? One, two, three, ... thirteen. Then from thirteen, how many she took? Let's count 10. Then where should we move this? Which box?
Some Ss	:Box of ten
T	:Then the remaining three, where should I put them?
Some Ss	:Box of ones
T	:How many altogether? How many in one bundle?
S	:Ten
T	:So, all together is ten, twenty,…*(teacher showed the straws to all student while guiding them to count)*
All Ss	:Thirty, thirty one, thirty two, thirty three
T	:So, is it correct that the answer is thirty three?
All Ss	:Yes
T	:Give applause for your friend

The excerpt shows that the teacher tried to establish student-student interaction, however as she had already determined what steps the students should do (using the 'tens' and 'ones' strategy), the student did not get much opportunity to explain her own strategy. In fact, it turned out that the teacher took over the discussion instead of giving time for the student to talk to her peers, consequently the excerpts were finally coded under ‘teacher-individual student’ interaction and ‘teacher-whole class’ interaction, instead.

Furthermore, the teachers in Utrecht also often set students to work in pairs or small groups. Some group work tasks were explorative, or a ‘doing mathematics’ activity. An example of this activity was the ‘jumping’ activity in the class of teacher UTR 2. Similar activity was also observed in the class of teacher UTR 3. In this activity, one student has to think about a number and demonstrate how the number is located on the number line by making real jumps down the school corridor, while her friend in the group has to guess the number based on the jumps she made. For example, a student made two big jumps that represent 20, and then three small jumps representing three. Thus, her friends would guess the number as 23. Interestingly, one student picked number 39 and made three big jumps and nine small jumps, as suggested. The teacher then brought up this incident in discussion with the whole class to learn about the relationship between numbers on the number line, and how this strategy related to their previous knowledge, as well as to the new content they were going to learn. This is shown below:

[Lesson 4, UTR 2]

T	: Look, how would you represent number thirty-nine on the number line?
Some Ss	: Three (big) jumps and nine small jumps
T	: Good (*She drew the situation on the board*). Can you make it in fewer jumps?
S1	: Is it possible to make four big jumps and then jump backward one small step?
T	: Excellent. (*She drew the situation on the board*). So, you go four big jumps, which makes forty, and then jump backward one small steps and it makes thirty-nine. You see here from thirty to forty, one jump represents ten. Then, (as you know) ten minus one is nine. Can we do this strategy for bigger numbers?
Ss	: Yes

It can be seen from the excerpts that the teacher related the activity with students' prior knowledge about 'making a friend of 10', and further explained that this strategy can also be used for bigger numbers. Later as students' learning progressed, this strategy might be used to solve problems discussed in section 7.3.1 (i.e. the problem of, '35 + 26').

7.3.3 Occurrences of Events Related to RME

Table 7.1 shows the occurrence of specific lesson events related to RME in the observed classrooms.

Activities/ Events	**UTR**	**JKT**
	(Of 12 Lessons)	
Use of contextual problem		
a. As a starting point of learning	12	4
b. As application during practice	12	6
Use of bare number problem	5	10
Use of model or scheme		
a. Concrete manipulatives	10	12
b. Introduction of schematization	12	7
Working step by step		
a. Fixed Instruction or Procedures to follow	0	10
b. Introduction of Standard Method	0	7
Making connection	6	0

Table 7.1 Occurrences of lesson events related to RME

From the table, it can be seen that the teachers in both places were found to use contextual problems as well as bring in some manipulatives, or introduce some scheme quite frequently in their lessons. However, the contextual problems were mostly provided as an application during practice sessions. In Utrecht, the contextual problems were utilized both as a source for learning, as well as an application. In these classrooms, six out of twelve lessons were also found to enact the idea of ‘making connections’ or ‘intertwinement’. In contrast, none of the lessons in Jakarta were observed to incorporate various mathematical strands (making connections). Besides, ten out of twelve lessons in Jakarta were also found to expect students to rigorously follow procedures or instructions provided by the teachers. Some examples of the lesson events related to each aspect are presented below:

Use of Contextual Problems

In terms of the use of contextual problems, the teachers in both places often used contextual problems. Comparing the problems with what was presented in the textbooks as discussed in chapter five, the contextual problems in Utrecht lessons were mostly taken from the realistic textbook, such as *De Wereld in Getallen*, while those in Jakarta lessons were mostly taken from the BSE textbook. None of the problems from PMRI tetbooks were used. Interestingly, one of the teachers in Utrecht often made her own real-life problems, instead of using the theme that is suggested by the textbook. This was mainly because she teaches a combination class (grade one and two) in which she has to manage discussion with the whole class, and needs a common theme appropriate for both groups. Some of the contextual problems provided in the classrooms are shown below:

<u>Example of Contextual Problems in Utrecht</u>

> *“I have 24 eggs and would like to put them on small egg boxes that can contain 4 eggs. How many boxes of eggs do I need to put them all? How if I have 36 eggs?”*
>
> *“A bag cost 8 Euro, what are the possible denominations that can be used to pay the bag using the combination of 5 Euro bank notes, 2 Euro and 1 Euro coins”*

"There was an analogue clock in the bus, but its half upper part was not visible, as it was hindered by curtain. We can only see that the minute hand pointing to number 6. How late do you think it was at that time?"

Example of Contextual Problems in Jakarta

"I have 48 straws and my friends have 26 straws. If we combine our straws, how many altogether?"

"On the table, there were 15 donuts. Mom put another 9 donuts. How many donuts are there now?"

"There are 26 star shapes in box 1, and there are 21 star shapes in box 2. How many star shapes altogether in the two boxes?"

The contextual problems in Utrecht classrooms were usually given at the beginning of a lesson, and used as a starting point to introduce a certain topic. For example, the egg box context above was used as a starting point to learn about the multiplication table of four. This is shown below:

[Lesson 1, UTR 2]
Students were asked to show their answers to the problem on a piece of paper.

T : Show your answers. What do you think? What do you see in the situation?

S1 : One box contains four eggs

T : Okay. Look at one of your friends' answer.

(The student drew a table, look like a ratio table, as below)

1	2	3	4	5	6
4	8	12	16	20	24

I think she is trying to say that one box can be filled in by four eggs. Two boxes can be filled in by eight eggs.Three boxes can be filled in by twelve eggs. Four boxes can be filled in by sixteen eggs. Five boxes can be filled in by twenty eggs, so six boxes can be filled in by twenty-four eggs. We can actually develop a multiplication table, right? How should we start?

Some Ss : One times four

T : Alright, what would we have if we have two boxes of eggs?
Some Ss : Eight
T : How about threeboxes?
Some Ss : Twelve
T : How do you know?
S2 : Two times four is eight, if you add four more then you get twelve.
T : How about six boxes?
S3 : Twenty four
T : How do you know?
S3 : Six is the double of three. So, it is the double of twelve, twenty four.
T : Great. How about nine boxes?
S4 : I will do from forty, which is ten times four, and then minus four which equals to thirty six

From the excerpt above, it can be seen that the teacher utilized the context of the egg box to build the multiplication table. Using a context that is familiar for the students, teachers guided the students in small steps to see the relationships between the mathematical concepts being discussed. In contrast, the contextual problems in Jakarta were mostly given during the practice session. The tasks were mostly used as an application of the content they had learnt. Furthermore, some contextual problems in Utrecht classrooms, such as the currency or the clock problem shown above, cannot be solved if the students do not place themselves in the context. For instance, the students in the class of teacher UTR 1 gave the following answers to the problem of the denomination of eight Euro:

[Lesson 2, UTR 1]
(During the lesson, students were working in groups to find three different ways to pay a bag that costs 8 Euros using bank notes of 5 or 10 Euro or coins of 1 or 2 Euros)
T : Who can tell with their group what they have done?
(Students raised their hands, and the teacher asked one of them to share his answer)
S1 : (*stand up and come forward*) First, I do 5 + 1 + 2 (*writing on the board*)

T	: So you have taken a bank note of five and a coin of two and a coin of one Euro?
S1	: Yes
T	: Together is eight. So that's good.
S1	: And then I pay '5 + 2 + 1' (*wrote on the board*) and then I pay 1 + 5 + 2 (*wrote on the board*). They are three different ways to pay.
T	: Thank you. Who thinks that these are three different ways? And who says not? And whoever tells No, please explain.
S2	: They are just the same things to me. He reversed the numbers.
T	: So basically what you're saying is you get the same things in here. Please come here. I'm going to pay you five, two and one Euro. What do you have at your hand? A bank note of five, a coin of two Euro and a coin of one Euro. What have you got in your hand? How does it look? Are they different?
S1	: No.
T	: Let's make a deal. Who of you have used currencies other than just these three? Come here, say it.
S	: [stand up] Here I did three Euro and then two Euro and three Euro (*draw the bank notes/coins on the board*).
T	: Well, three and two and a three Euro. Thank you, sit down. Do the whole group agree with that? Then we go check it out. It is a good in itself, it is together eight. That's no problem, but I've got the coins. Where do you see the currency of three euros?
All Ss	: Nowhere.
T	: We cannot write it down, as the coin of three Euro does not exist. You cannot use coins that are not there. You cannot invent a currency of three Euros for now. Any other ideas?
S	: [stand up] I had five, one, one and one.
T	: Look (*show students the bank notes and coins from the envelope*). five and one is six, then plus one is? Then seven plus one is eight. That's good. And we found another way to pay. Do you see this really other ways to pay?
All Ss	: Yes

From the excerpt, it can be seen that the currency context above requires students to think about the problem within the true reality of the situation, and allows them to have multiple solutions. To solve the problem, one cannot separate the numbers from the context being discussed. It may not be solvable by simply applying certain fixed procedures. Furthermore, they have need of the student to learn a ‘solution attitude’, rather than a ‘solution method’. On the other hand, contextual problems in the Jakarta classrooms had one answer and were in the form of ‘word problems’ as discussed by van den Heuvel-Panhuizen (1996). These kind of problems, in fact, are often presented as application problems in traditional classrooms. “One context can be exchanged for another without substantially altering the problem” (p.20). For instance, problems involving straws might be replaced by the problems involving donuts, or star-shaped objects. This has actually shown that the Indonesian teachers are still coming to grasp with what are contextual problems in the RME context.

Use of Bare Number Problems

During the observations, teachers in both places also gave some bare number problems to students. In Jakarta, however, this was observed more frequently, and teachers mainly asked for the final answer. In Utrecht, the teacher normally asked students to explain their strategy used for solving the bare number problem, even when they already knew the answer. An example of this situation is shown in the excerpts of lesson four, of teacher UTR 1 in section 7.3.2 above. From the excerpt, although one student has correctly answered the question ’11 + … = 20’, and it has been known that the answer was nine, the teacher provided the opportunity for other students to think about the problem and if they understand their friends’ answer, or if they might solve the problem differently and still get the same answer. It seems that not the final answer is important for the class, but rather the focus was on understanding the strategies that brought them to the answer.

Use of Models and Schemes

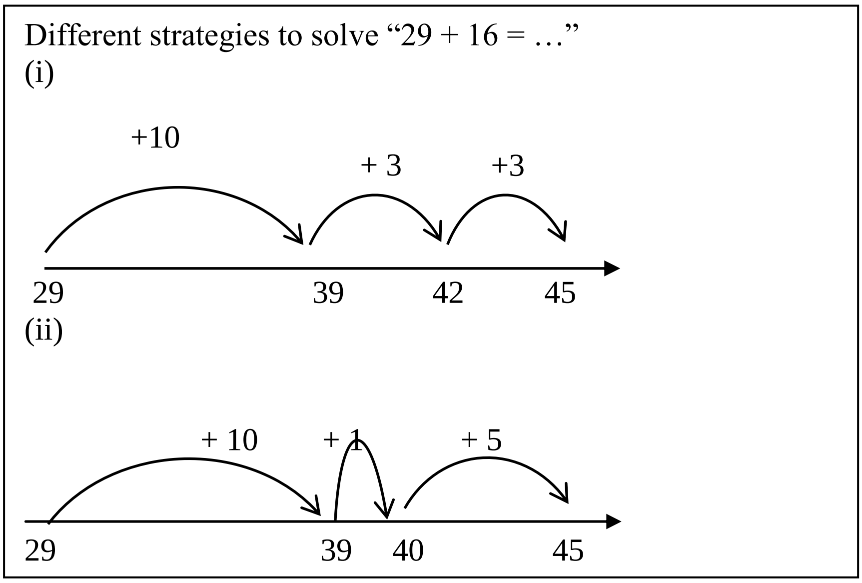


Figure 7.4 Use of schematization in Utrecht classroom

In terms of the use of models and schemes, all of the observed teachers were found to often employ some concrete teaching aids in their mathematics lessons. Some concrete manipulatives utilized in Utrecht classrooms include small cuboid wooden blocks, an arithmetic rack, fake bank notes and coins, number match, number weight balance, and egg boxes. These manipulatives may have different functions for different students. It was observed that sometimes students in the same class used different tools in solving a task, while others did not use any of the tools. Besides, the teachers in Utrecht also introduced some schematizations or strategies that include the split table and number line. For example, the teacher introduced the 'empty number line' strategy to do addition of numbers up to 100 in the grade two of the combination class class. Some samples of students' work in solving addition problem using this strategy are shown in figure 7.4.

In Jakarta, however, the concrete teaching aid utilized to teach 'addition and subtraction' was limited to the use of 'straws'. Below is an example of the use of straws as the teaching aid in one of the lessons, which looks similar to some other lessons:

[Lesson 4, JKT 2]

Teacher put some straws sticked on the board, 13 straws and 22 straws, as visualized below.

```
||||||||||  |||     + ||||||||||  |||||||||| ||    = ||||||||||  ||||||||||  ||||||||||  |||||
   13        +          22         =          35
```

T	OK. Now I have straws in here. How many of straws do I have? Let’s count together. Ten…
Ss	Ten, eleven, twelve, thirteen…
T	Thirteen, plus what?
Ss	Twenty
T	Twenty? Let’s count together. (her finger pointed to the straws on the board). Ten, twenty…
Ss	Ten, twenty, thirty
T	Thirty?
Ss	Eh, twenty one, twenty two
T	Be careful. You have tens and ones, tens and ones. (pointing to the straws that tied up in tens). If you add them, you put them together. Now, how many ones and how many tens?
Ss	Five
T	Ok. One, two, three, four, five. How many tens?
Ss	Thirty
T	Smart. Let’s count together. Ten..
Ss	Twenty, Thirty, Thirty-One, Thirty-two, Thirty-three, Thirty-four, Thirty-five. (teacher was pointing to the straws while guiding students to count on)
T	Actually if you put them together, it will look like this (she drew the tally as representation of the straws on the board). So, how many tens? Added, put together, so again, how many tens?
Ss	Three

T	So, how many ones?
Ss	Five
T	Five. Lets count again. Ten.. (pointing to the straws)
Ss	Twenty, thirty
T	Thirty one (pointing to the straws)…
Ss	Thirty two, Thirty three, Thirty four, Thirty five
T	Thirty-five. It's like this. So, if you add them together, you have to see how many tens and how many ones. Combine them.

In the excerpts, the teacher aimed to introduce how to add two numbers using the tens and ones structure. It can be seen that instead of directly telling them how to add the numbers, the teacher first involved her students to count the straws she had on the board, and then make a conclusion on how to do it. Here, the teacher used the straws as the concrete object, and its illustration represents the model *of* the contextual situation which may lead to the use of a model *for* more general counting (i.e. schemes). However, it was not very clear how the model can help the students to count to numbers up to 100.

In another lesson, one of the teachers (teacher JKT 3) also asked students to bring their own straws from home. She asked students to get twelve straws and then add nine straws more. She then told the students that they should separate the 'tens' and 'ones' in the result. She expected the students to see that twelve straws could be structured into one bundle of ten and two ones, and that by adding nine more straws, the students would have to make two bundles of ten, and one loose straw. In fact, it was observed that most students put 12 'on their head (or mouth)' and then counted 'one by one' as many as 9 times using their fingers, instead of using the straws as suggested. Seeing students doing that, the teacher insisted that students should use the straws to get the answer. The below excerpt illustrates this situation:

Teacher	*: Twelve plus nine, which of these are tied, and which are loose? How many straws do you have in a bundle? Now twelve and nine, how do you add them? Use the steps do not just give me the answer, 21.* ***I do not like it. Use your straws,***

please. *Then, do you see if there are things to be tied? How many? Take your straws and count.... Now, everyone looks. Twelve plus nine, I will tell you. Where is your twelve straws? Then add by nine straws. Make them all loose and then tied up every ten. I will give you the rubber band to tie them up. [Lesson 4, JKT 3]*

Working Step by Step

In terms of a scheme to solve an addition and subtraction problem, the three teachers in Jakarta also introduced some sort of scheme as shown in figures 7.5 and 7.6. For example, teacher JKT 2 introduced the 'horizontal scheme' as shown in figure 7.5, and another teacher introduced the column method, as shown in figure 7.6. However, in applying the scheme to solve an addition problem, students were expected to follow several fixed steps rigorously. In the horizontal scheme shown in figure 7.5, the teacher labeled the tens with *p* (*puluhan*) and the ones with *s* (*satuan*). Thus she illustrated that *p* can only get along with *p,* and when the two *p* were added, the result should also be in the *p* place on the right side, and similarly for *s*.

P S + P S = P S

Figure 7.5 'Horizontal Scheme' to solve addition task

For example, to solve 13 + 22, we have:

1 3 + 2 2 = 3 5

p s + p s = p s

Here, instead of treating thirteen as ten and three, she put it as one (tens) and three (ones), and so on for 22 and 35. In her lessons, she reviewed this method repeatedly. In fact, the addition scheme above was given as a fixed format to solve the task, and the students were expected to follow the steps and method exactly as explained by the teacher. Thus, it was observed that the students have to use this method, exactly with all the *p* and *s* symbols, to solve similar tasks. She mentioned that in following this scheme, the students would learn the column method, which is also presented in the class of teacher JKT 1.

$$
\begin{array}{llllll}
48 & = 40 & + & 8 & & \\
\underline{26} & \underline{= 20} & \underline{+} & \underline{6 \quad +} & & \\
 & = 60 & + & 14 & & \\
 & = 60 & + & 10 & + & 4 \\
 & = 70 & + & 4 & & \\
 & = 74 & & & &
\end{array}
$$

Figure 7.6 Column methods to solve addition task

Making Connections

In relation to the concept of exploring mathematical relationships as suggested by RME, none of the lessons in Jakarta were found to integrate different mathematical strands, as they were organized in working units. Students learnt one particular mathematical topic (i.e. addition of two digit numbers) in one lesson during a certain period of time (two to four weeks). During the observations, the lessons only covered the topic of addition and subtraction up to 100, as suggested by the national curriculum. In Utrecht, during the twelve lessons observed, the mathematical topics introduced were varied. In grade one, the lessons covered the following topics: the addition and subtraction of numbers up to 20 (with some application in measurement of weight and in currency problems), and the measuring time. In grade two (of the combination class) the lessons covered the addition of numbers up to 100, multiplication, and measuring time. In one lesson, the teachers would teach two or three topics. For example, one teacher in Utrecht taught addition and multiplication in her first lesson, and another teacher taught addition and measuring in her fourth lesson.

In one of the lessons, some activities that incorporated various mathematical strands also involved some trial and error activity, below is an example:

[Lesson 3, UTR 2]

T	: Now, we will learn again about splitting strategy of numbers up to 20. Yesterday you have done the loving hearts (*verliefde harten*). I discovered this thing (*kind of scale shown in figure 7.7*). Which number we found difficult to find the right twins?
Some Ss	: 14, 16, 18
T	: 18, what it consists of?
Some Ss	: 10 and 8
T	: The scale goes all the way. What should I hang up in here so that they are balanced?
S1	: 10 and 8
T	: Are they twins? Which twins fit in there?
S2	: 8 and 8
T	: That's we are going to try (*she put on number 8 and 8 on the other side of the hand of the balance scale*).
Some Ss	: No they are not balanced.
S3	: How about 10 and 10? (*Teacher then hung in number 10 and 10*)
S4	: That's 20
T	: What do I have to go now to get it right?
S5	: Nine
T	: Nine and nine, there is together equal to 18. They are balanced now.

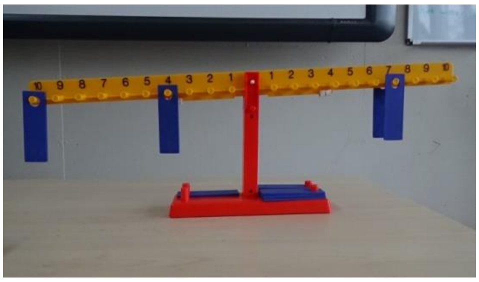


Figure 7.7 Hanging balance scale

This activity integrated the topics of measuring weight, addition of numbers up to 20, and the concept of doubles, in one contextual problem. Here, the students were first asked to choose a number between eleven and 20, and then had to find ways of decomposing this number into two numbers. To prove whether they had a good composition of the numbers, they can test them out using the 'number balance' scale.

7.4 RME Reflected in the Lessons

From the description in the previous section, there were consistencies and inconsistencies between the teaching practices of the teachers in Jakarta and Utrecht in relation to RME. While variations of RME implementation among Utrecht classrooms was apparent, wider gaps were observed between the RME implementation in the two places. Following is the discussion on how each principle of RME was enacted in the lessons.

1. Reality Principle

In terms of the use of realistic or contextual problems, teachers in both places were found to provide contextual problems for their students. However, teachers in Jakarta were found to give bare number problems more often than problems with context. Besides in Utrecht, the contextual problems were utilized as both a source for learning and as application, but they were mostly utilized as an application in the Jakarta classrooms.

While some contextual problems in Utrecht were based off a real-life problem and allowed students to have multiple solutions, in Jakarta classrooms the contextual problems were rather dressed up bare number problems which had only one answer.

2. Level Principle

Teachers in the two places often brought in concrete teaching aids, as well as introduced schemes, tables, or other general models during the lessons. In Utrecht, the concrete manipulatives provided were more varied and their usage was more flexible. Students could choose the concrete materials as they think appropriate and useful to help them solve the task. The schemes introduced, such as the empty number line, also allowed students to use a different method to solve the addition task. In contrast, in Jakarta, students used the same and single concrete material, the straw, as a model in learning addition and subtraction. The schemes introduced, such as the column method, unfortunately also lead the students to use a standard method of fixed procedures to solve the task.

3. Activity Principle

In terms of lesson activity, teachers in Jakarta and Utrecht spent significant lesson time practicing an activity. In Utrecht, teachers sometimes provided students with activities that allow students to explore the contextual problems or activities of ‘doing mathematics’. In doing the independent tasks, the less able students in Utrecht classrooms mainly did the basic tasks, while some more skilled students did more advanced. In contrast, students in Jakarta had to do uniform and exactly the same tasks during their individual work.

4. Guidance Principle

Teachers in the two places also actively provided necessary assistance for students during the ‘practicing’ activity. In Utrecht particularly, the three teachers were observed providing more assistance to individual or groups of students that were identified as weak by providing a ‘special table’ for them to work together, or by assisting them in private throughout the ‘practice’ session. However, in Jakarta, given teachers made intensive contact with students both in private or as a whole group during the practicing activity, teachers often focused on examining whether the students do the tasks correctly, rather than helping them to learn. During the introduction of content, the teachers in Jakarta also often provided rigorous examples or instructions for students to follow.

5. Interactivity Principle

It was observed that during the whole class setting, the ‘teacher-whole class’ interaction, as well as ‘teacher-individual student’ interaction, dominated the methods of interaction in all classrooms. In Utrecht, there was a significant amount of lesson time for students to work in groups, and for ‘student-student’ interaction. Here, students were encouraged to express opinions, with respect to others’, and explaining their strategy was appreciated more than only giving the correct answer. During the discussion, the students were also encouraged to compare different ways of solving a task, criticize other’s work, and sometimes learn from other’s mistakes. The classroom discussion also gave opportunity for students to reflect upon their own thought process, as well as that of others. Some of the students in the Utrecht classrooms showed initiative to start a discussion. Here, without being asked, the student tried to build his own knowledge and at the same time contribute to the whole class learning. While this ‘student-student’ interaction took place quite often in Utrecht classrooms, it occurred infrequently in Jakarta. Teachers in Jakarta actually tried to promote reasoning in their classrooms by encouraging students to explain their strategies. However, as students did not give the expected responses, teachers often decided to take over the discussion too soon. It was also noted that none of the excerpts in the twelve lessons were coded under the ‘individual student-teacher’ interaction, which showed students lack of initiative to ask questions, or to initiate a discussion.

6. Intertwinement Principle

In Utrecht classrooms, some of the activities also incorporated various mathematical topics and made connections between them. In one lesson, the teacher taught more than one topic, such as numbers (addition, multiplication, number structures) and measurement (measurement of time, currency). Some lessons also aimed to give opportunity for students to do some exploration, and sometimes to do trial and error activities. It seemed that the contents were not the focus of the lesson, instead the emphasis was placed more on the students’ cognitive development. In contrast, in Jakarta none of the lessons integrated different mathematical strands. They only covered one topic, namely addition and subtraction topic for the four consecutive lessons observed.

7.5 Discussion

From above, while the implementation of RME in Utrecht was found to be more consistent with what was suggested by the theory, some inconsistencies were found in Jakarta. One could actually anticipate this result, as teaching and learning mathematics is regarded as a cultural activity (Leung, 2001; Bishop, 1988), and it is quite natural for the implementation of RME in its original culture to be more consistent with the proposed theory, than that of their counterparts elsewhere.

Some findings in this chapter are also in line with findings from previous classroom studies that compare Indonesian and Dutch classrooms. For instance, a study by Johar, et al. (2017) in research about teacher questioning in RME classrooms found that Dutch students demonstrated a broader repertoire of, and more flexible strategies in, solving a given task. While the Indonesian students performed more uniformly to solve a task. Besides, the Dutch classroom was more open to students' engagement and exploration than the Indonesian classroom. Another study by Maulana et al. (2012) also found that Dutch teachers spent less time introducing the content, but spent significantly more lesson time helping individual and groups of students during practicing activities than their Indonesian counterparts.

As argued in chapter six, the findings in this chapter might also be explained by the significant cultural differences between the two countries. In this chapter, culture may also serve to explain the consistencies and inconsistencies found in the following ways.

The fact that the teachers in both places provided individual and whole class assistance during practice, as well as allocated a significant amount of time to both 'teacher-individual student' and 'teacher-whole class interaction' have shown that the teachers tried to enact the idea of learning as an individual and as a social process. In Jakarta learning together in a whole class setting can be used as a way to educate students about collectivity and solidarity, which are stressed in their culture.

However, while differentiated tasks were provided for students with different abilities in Utrecht, the tasks provided for students in Jakarta were uniform. This uniformity was also observed in terms of concrete materials and models used. These findings may actually reflect the most significant values appreciated in the two contexts; the collectivist perspective in Indonesia and the individualist perspective in the Netherlands might explain why such practices occurred in the observed classrooms. For instance, personal interest is very limited in a society like Indonesia, and it may be regarded as unnecessary to provide different levels of tasks for students of different abilities, or to let students choose the concrete models that work for them.

As a society with a low masculinity score, the sign of success in Dutch culture is the quality of one's work (Hofstede et al., 2010). In relation to learning mathematics, it is important for them to have a meaningful learning experience, for example through a meaningful context or activity. In Jakarta, to build students' motivation, and invite students' participation, the teachers were observed to give rewards in the form of additional points or praise. They were also found to emphasise the product of learning, the final answer, rather than the process of learning, strategies to get the answer, as the Dutch do.

The emphasis of compliance and obedience (*manut* and *runtut*) in Javanese culture might also explain why the PMRI teachers stressed rule-following (i.e. standard method or procedures), much more than the teachers in Utrecht. In Javanese society, following the norms in a fixed way are important, and has to be nurtured from a young age. Therefore, the rules and formula introduced in the classroom may serve as the guide for students to work from, and as a self-measurement tool to reduce the contradiction within oneself or between individuals and others. Moreover, an emphasis on harmony in Javanese culture might reflect why horizontal interaction was absent in the Jakarta classrooms. As argued in the previous chapter, Javanese society aspires to a calm state of mind, and wishes to avoid open conflict. Thus teachers may avoid horizontal interaction between students, as it may result in disagreement that can disrupt the harmony of the classroom. Teachers may believe that direct interaction between students may risk an open conflict, and therefore should be avoided. In contrast, Utrecht classrooms are more open to students' engagement and disagreement of opinions. From the student side, students in Jakarta also did not show initiative to ask questions or to initiate a discussion.

Even when giving their answer, students often waited for teachers to give the instruction on what they could or could not do. This may actually reflect the classic Guru-student relationship of the Javanese tradition, where teacher and student have unequal power in the classroom and therefore, teacher (*guru*) is inaccesible.

This classic relationship in which the teacher is regarded as a source of learning and as a knowleadgable person may also explain why the teachers in Jakarta provided prevalent examples in their lessons and required students to follow their examples and instruction rigorously. Furthermore, while the Utrecht classrooms were more open to exploration and activities that involved trial and error, the lessons in Jakarta were organized in working units, and the contexts were mainly provided as application, and the teachers were found to spend more time introducing the mathematical contents. This difference might also be attributed to the Javanese tradition that suggests knowledge is something that has already been formulated, not something to be discovered. Classic knowledge, such as mathematics, was regarded as something that has been formulated, and therefore students only need to learn it as it is given. It is not necessary to have exploration of such kind of knowledge.

It is not the intention of this study to argue that culture serves as a single explanation for the findings. The differences in curriculum, textbook, and school facilities and arrangement might also contribute to the findings. As discussed in chapter five, the Dutch teachers may have advantages from the availability of specially developed RME textbooks, and from the absence of a centralized decision of the contents to be covered. On the other hand, the effort of Indonesian teachers to implement ideal RME-based lessons might be limited by the heavy curriculum content and textbooks that have not fully adopted the RME ideas. Even when such book exists (i.e. PMRI textbook), its presentation and contents might not match well with the curriculum suggestion.

Moreover, the fact that the Indonesian curriculum is structured in a content-based approach, while Dutch curriculum is more flexible, allows teachers to incorporate various mathematical strands into a single lesson. This may explain why the teachers' practice in the two countries was different. However, there must be a reason why the government chose this approach over the alternatives. The discussion on the school and societal aspect, as well as the discussion of the influence of the teacher attitudinal factor towards their practice will be presented in the following chapters.

Chapter 8 - The Consistency between Teacher' Attitudes towards RME and the Classroom Implementation

While chapter seven discussed the teaching practice of three PMRI teachers in general, this chapter analyses their instructional practice in-depth and discusses its relation with their attitudinal score in the survey described in chapter six. In section 8.1, the attitudinal score of the three teachers and the analysis of their lessons are presented, and in section 8.2 the consistency between the two are discussed. This result is further supplemented by results of interviews with each teacher in section 8.3, to better understand the consistencies or inconsistencies found.

8.1 Teacher Attitudinal Score and Analysis of the Lesson

As described in chapter seven, the three observed teachers in Jakarta are all teaching grade one, with teaching experience with PMRI of more than ten years. The school facilities of the three classrooms do not differ significantly from one another, although variations in terms of seating arrangement and class size were apparent. The class size was 32 in the class of teacher JKT 1, 20 in the class of teacher JKT 2, and 43 in the class of teacher JKT 3. In the class of teacher JKT 1 and JKT 3, students were sitting in rows, while in the class of teacher JKT 2, students were sitting in small groups. These differences in facilities and arrangement should also be considered in the analysis that follows.

Prior to the observation of their teaching practice, the three teachers in Jakarta participated in the survey described in chapter six. Below are the attitude scores of the three teachers for overall questions, and in each factor:

Teacher	Attitude Score				
	Overall	**ITN**	**GDN**	**SDM**	**INT**
JKT 1	3.29	3.94	2.50	3.36	2.85
JKT 2	4.19	4.83	3.50	4.18	3.71
JKT 3	4.21	4.88	3.58	4.09	3.71

Table 8.1 - Attitudinal Score of Three Teachers in Jakarta

As shown in table 8.1, all teachers scored high in the ITN factor that is related to the ideas of using contextual problems, models and schemes, making connections between mathematics and real life, or between mathematical topics, as well as the importance of a review session to activate students' prior knowledge. However, teacher JKT 1 had a particularly low intention towards the guidance and interactivity factor (M = 2.50 and M=2.85). The items within the GDN factor are related to the nature of guidance provided in the classroom, including the use of fixed methods and standard methods, an emphasis on right answers, and formal tasks. The items within the INT factor are related to both vertical and horizontal interaction in the classroom.

Given the two teachers had considerably high disposition towards this approach, some aspects of their lessons were found to be inconsistent with RME ideas. To discuss this inconsistency, the analysis of their lessons is presented below in figure 8.1:

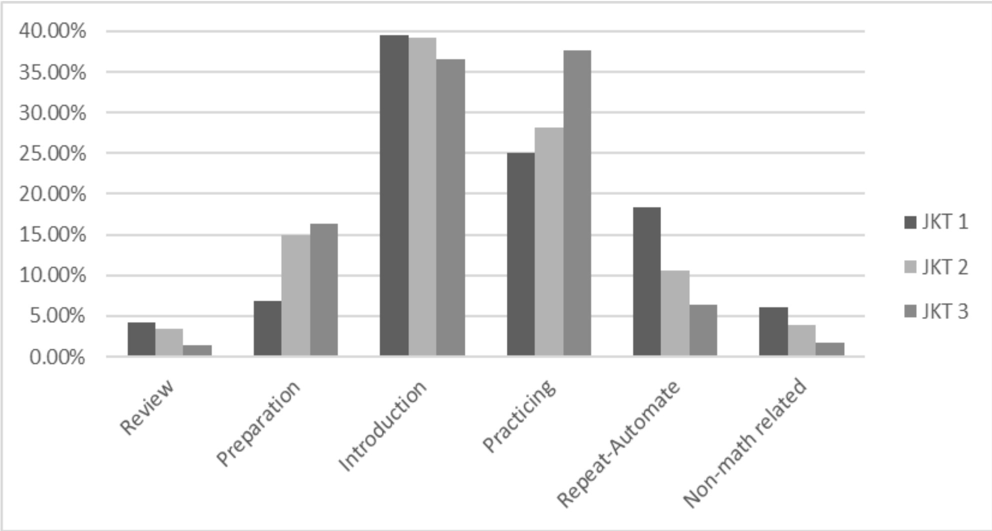


Figure 8.1 Lesson structure in Jakarta classrooms

Figure 8.1 shows that the three teachers spent a significant amount of lesson time introducing the content (above 35%). During the introduction session, as discussed in chapter seven, the three teachers were often found to provide rigorous examples and working sample questions. While teacher JKT 1 spent less time for practice sessions, and more time for repeate-automate sessions, the other two teachers spent more time for practicing sessions and less time for repeating-automate sessions than she did. She was also found to spend less time for preparation than her two peers.

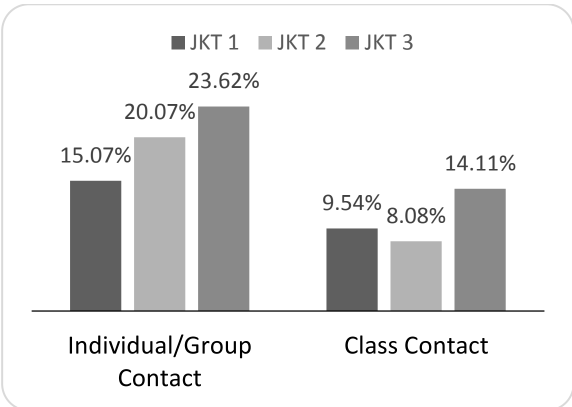


Figure 8.2 Teacher involvement during Practice in Jakarta classrooms

During practice sessions, the teachers also provided a considerable amount of time to having contact with individual students, or groups of students (see figure 8.2). However, as discussed in chapter seven, during the individual contact, the teachers were found to often focus on whether the individual student had a correct answer, instead of helping them to understand the tasks that were uniformly given to all students, regardless their academic ability. From the figure, it can also be seen that teacher JKT 2 spent less time on class contact compared to the others. This can be understood as the class size is rather small, and students have been seated in groups of three or four. This situation allowed her to spend most of the time talking to individual students or a group of students. On the other hand, with 43 students in her class, it can be understood why teacher JKT 3 spent more time on whole class contact during practicing.

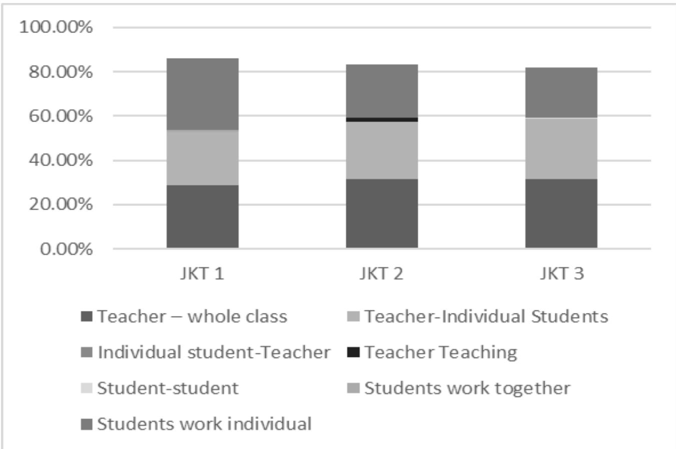


Figure 8.3 Methods of interaction in Jakarta classrooms

In terms of methods of interaction, the practice in the three classrooms were rather similar. The methods of interaction were limited to the 'teacher-whole class' and 'teacher-individual student' (see figure 8.3). The horizontal interaction was missing in these classrooms (or if any, they were insignificant). None of the lessons allocated time for 'student-student' interaction, and only a small proportion of lesson time in the class of teacher JKT 1 (0.98%) was allocated for students to work in groups. In one of the classrooms, the teacher actually tried to establish student-student interaction by inviting individual students to explain their answer in front of the class, however, it turned out that the teacher often took over the discussion. An example of this situation was also presented in some excerpts in chapter seven (section 7.3.2). Given that the class size and seating arrangement in the class of teacher JKT 2 was conducive to group work, it was surprising to find that group work was absent from her lessons.

Activities/ Events	**JKT 1**	**JKT 2**	**JKT 3**
	(Of 4 Lessons)		
Use of contextual problem			
c. As a starting point of learning	1	1	2
d. As application during practice	1	2	3
Use of bare number problem	4	3	3
Use of model or scheme			
c. Concrete manipulatives	4	4	4
d. Introduction of schematization	4	2	1
Working step by step			
c. Fixed Instruction or Procedures to follow	4	3	3
d. Introduction of Standard Method	4	2	1
Making connection	0	0	0

Table 8.2 Occurrences of lesson events related to RME in Jakarta classrooms

In terms of lesson events related to RME, while the teachers frequently used contextual problems, they were also found to give a lot of bare number problems to the students (see table 8.2). Yet, the contexts were mostly given after teachers had introduced the content, during the ‘practicing’ session. Furthermore, as discussed in chapter seven (see section 7.3.3), while the three teachers often brought concrete teaching aids and introduced schematization, the models were rather uniform and the schemes they introduced often directed students to work using fixed procedures or standard methods. Furthermore, their lessons were structured in working units in which they focused on teaching a single mathematical topic until their students had a really strong mastery of it before moving on to the next topic.

8.2 The Consistency between Teachers' Attitudes and Their Practice

The consistencies and inconsistencies between teachers' responses in the questionnaire and their observed practice at the classroom are discussed below.

1. Teacher Intention of Realistic Education (ITN)

Given all the three teachers had considerably high score towards the ITN factor, the above analysis showed that there are consistencies and inconsistencies between teachers' attitudes and their teaching practice. The consistencies include the number of lessons involving contextual problems, using models, or introducing some sort of schematization.

While all teachers were observed to always provide concrete manipulatives, they were found to use contextual problems in their lessons differently. Teacher JKT 2 and JKT 3 were found to use the contextual problems more frequently than teacher JKT 1, who had a lower score on this factor. She in fact provided her students with bare number problems more often than her two peers. However, the use of contextual problems in their lessons were mainly given after the introduction of the lesson content.

Moreover, as discussed in the previous chapter, the concrete manipulatives used were rather uniform and artificial, and the schemes they introduced often lead to the introduction of standard procedures. Besides, the intertwinement principle that suggests teachers should give an opportunity for students to see the connections between different mathematical concepts, or their relations with other subjects, was absent in their lessons.

2. Guidance(GDN)

As for the GDN factor, while two teachers showed support towards these aspects of RME, their teaching practice was rather similar to teacher JKT 1, who had a very low score on this aspect. The three teachers spent a significant amount of lesson time introducing the content in which they often provided students with rigorous examples and worked on sample questions. In most of their lessons, the teachers also required students to rigorously follow their instructions. Yet teacher JKT 1 was found to introduce standard methods more frequently. Moreover, during individual contact, the teachers were found to often focus on whether the individual student had a correct answer, instead of helping them to understand the tasks.

3. Students' Self Development (SDM)

In relation to the SDM factor, some consistencies between the teacher's response and their classroom practice was observed. The teachers provided significant lesson time for students to practice, as well as spent significant time for individual or small groups' assistance before talking about the problems with the whole class. In terms of the teachers' involvement behavior during practice sessions, teacher JKT 2 spent less time for class contact compared to the others, as her class size is rather small and students had been seated into groups. On the other hand, with a large class size, it can be understood why teacher JKT 3 spent more time for class contact during practice with a whole class method. However, the problems provided during practice sessions were uniform for all students. All students, regardless their academic ability, had to do the same tasks. Besides, teachers did not give much room for students to develop their own strategies, as they gave rigorous examples and expected the students to follow their instructions closely.

4. Interactivity (INT)

All teachers dedicated significant lesson time for vertical interaction. This is shown by the time allocated for ‘teacher-whole class’ and ‘teacher-individual student’ interaction. There was also insignificant time spent for chalk and talk without involving student participation. However, the horizontal interaction was missing in the lesson. None of the lessons allocated time for ‘student-student’ interaction, and only a small proportion of lesson time in the class of teacher JKT 1 was allocated for students to work in groups. In the class of teacher JKT 3, she actually tried to establish student-student interaction, however, it turned out that she often took over the discussion. It was also surprising to find that group work was absent in the class of teacher JKT 2, where students were already sitting in groups.

8.3 Interview Results

To better understand the factors that may contribute to the consistencies and inconsistencies between teachers’ beliefs and practice, this study conducted an interview with each teacher after the observation. The interview was performed in *Bahasa* Indonesia.

Realistic Approach

As an opening, the researcher asked teachers what they learned the most from the PMRI approach. Below are their responses:

> “Since I used the approach, my students **are not frightening anymore about mathematics**. I often bring some **concrete teaching aids** to the classroom, so they like it. Compared to my old time before I use PMRI, it seems that my current students **enjoy the mathematics lesson and very active** much more than the previous groups.” [Teacher JKT 1]

> “I like that PMRI encourage learning to start **from something concrete and progress to a more abstract mathematics**. Before learning the mathematical formula, students can learn using concrete objects and pictures. So, it is **good for their understanding**.” [Teacher JKT 2]

According to the teachers, RME offered joyful learning to their classroom and encouraged students to actively participate, particularly compared to their time before teaching with PMRI. The use of concrete objects was also among the important aspects of RME style teaching. It seems that they perceived ‘realistic’ as ‘real’ or ‘concrete’. It is also interesting to find that one of the teachers had a concern about the *iceberg* idea, which suggests learning mathematics should be started from the concrete then move to a more abstract level. However, looking at her teaching practice, it seems that she interpreted the tip of the iceberg, formal mathematics, can be reached in two or three lessons. In her lessons, it was observed that she introduced the P-S scheme (see section 7.3.3) in the third lesson, soon after she asked students to use the straws as a concrete manipulative to solve the addition problem.

Contextual Problem as Application

In relation to the use of contextual problems as an application, the teachers mentioned that this practice is in line with the recommendation from the curriculum which suggests problem solving tasks are to be given at the end of each lesson chapter after the content mastery. But there was a concern that contextual problems may confuse the students. Here are some comments from the teachers in response to the question: In the questionnaire you agree that contextual problems are meaningful, however you barely start the lessons by giving contextual or realistic problems. Please comments on this:

> "I usually **teach all the content first**, especially for teaching mathematical operation. **Without strong understanding, it is difficult for students to solve problem with context.** This is also what **syllabus** recommends.**"** [Teacher JKT 1]

> "I usually give **contextual problem after concept**. It is actually **very good for the students, more meaningful**. However, **according to the syllabus** [*in the national curriculum*], most of the time, the contextual problem or problem solving shall be given after the concept. So, I just follow the order, concept comes first then problem solving task will follow." [Teacher JKT 2]

> "**Problem with context is more interesting**, but my students are still developing their language. The stories **may confuse them**. In the textbook, word problems are also given at the end." [Teacher JKT 3]

From the transcript, it can be seen that while teachers think the contextual problems are interesting and meaningful, they had a concern about students' ability to understand the context. Students may not cope with their teaching if they provided a contextual problem before introducing the content. Teachers think that without strong content mastery, it is difficult for students to solve the given problems. On the other hand, teachers noted that many of their students were still developing their language abilities, and therefore the contextual problems may not be appropriate for them. They also argued that this practice is in line with the expectation as described in the syllabus and curriculum guidelines. Chapter five discussed how the teaching supports, in terms of the curriculum guideline and textbook, may affect teachers' interpretation of how teaching and learning mathematics should take place. For example, the fact that the curriculum (and BSE textbook) suggests problem solving as a separate competency to be taught after the delivery of content has influenced how this suggestion is enacted in the classroom, regardless of if the teachers have the right beliefs or not.

Introduction of Standard Method

In response to the question about the prevalent use of standard methods in their lessons, the teachers saw the method as a guidance and reference for students to work with for similar problems in the future. Here are some comments from the teachers in response to the question: What was the purpose of introducing 'column' method or any standard method in your lesson?

> "The column method I introduced can be used as a guideline for them **to solve similar task**. I also gave some **examples and how to apply it**, so they will remember the example I gave in long term. During my old time, we directly learned the formal mathematics without use of any models. In my lesson, as you can see, I **use the straw before introducing the column method**" [Teacher JKT 1]

> "If you remember the **P and S scheme** I introduced, I know that some of my students may not need it. Some other may not understand how to use it at all. But, **most of my students find it useful to solve similar task in the future**. So the **rule can guide them** in solving the problem and **it always works**." [Teacher JKT2]

According to the transcript, teacher JKT 1, in particular, compared her teaching with the methods of teaching during her own education. She thought that her teaching is different from traditional teaching that primarily teaches formal mathematics directly. In fact, this experience has influenced the way she teaches. While she utilized concrete teaching aids (straws), as suggested by RME, her focus was on introducing the standard methods. Similarly, teacher JKT 2 also found the standard method as very useful for her students, although she noted that it might not be easy for some students to understand how the formula works.

Worked Sample and Solution

The researcher also asked the teachers on the purpose of providing a worked sample, and how to solve a typical task during the introduction session. Below are some comments from the teachers in response to the question: What is the purpose of providing worked sample with detailed steps in your lesson?

> "**It is the way I teach**. I usually **start with giving some examples**. For instance, **I showed them how to do addition of two numbers with column method, then give some similar problems for students to practice**. If needed, I will give some additional tasks until they understand. I also usually asked some students to share their works on the board." [Teacher JKT 1]

> "It is **important I think to give them examples and more importantly on how to solve it**. Without my **example, how can they solve the problem**?" [Teacher JKT 2]

The teachers agreed that providing examples are important in their lessons. The examples can be used by students to solve similar problems during the 'practice' phase. For teacher JKT 1, it is almost inevitable for her to provide examples, as it is the way she introduces the mathematics. Interestingly, her statement in this interview is in line with the fact that she scored low in the GDN factor. As shown in chapter seven, she often asked students to rigorusly follow her methods and to copy the answers shared on the board.

Uniform Tasks

During the individual tasks, the teachers also gave uniform tasks for all students, regardless their mathematical ability. Here are some comments from teachers in response to the question: Why do you give the same tasks to all students, regardless their ability? How do you accommodate students with different ability level?

> "The tasks are, of course, the same. The textbooks did not [differentiate the task] either. Some students may think that it is **unfair** (*tidak adil*) **if I gave easy questions to others while giving difficult questions to them**. On the other hand, in **public school** like us, we don't have any assistant like the **private schools** do. It is not possible to give special attention to the **weak students** all the time. I also realize that some of my students are **very smart**, and they usually help other students after they finish their tasks" [Teacher JKT 1]

> "In the class, **everyone will learn the same thing, the same standard**. In **our school**, teachers have an assistant. In my class, my assistant usually **helps the weak students** to solve the tasks. **But the tasks are the same**. **The textbooks** also did not differentiate tasks for students, right? They may have **remedial or enrichment** after shool, if needed." [Teacher JKT 2]

As shown in the transcript excerpts above, the teachers realized that some of their students may have special needs. Both weak and superior students needed different treatment in the classroom. However, they gave the same tasks for all students during lesson time, which is also in line with the suggestion from the textbook. Interestingly, teacher JKT 1 cited the large class size and the lack of teacher assistance as barriers to enacting differentiated tasks, teacher JKT 2 who had an assistant and a smaller class size did not enact this idea in her classroom. They think that it is important for all students to learn the same standard to be fair to everyone. On the other hand, the differentiated tasks may disrupt the harmony of the classrooms as this might invite jealousy from the students. If remedial or enrichment activities are provided, they will be given in private after school.

Horizontal Interaction

The teachers also gave some comments about horizontal interaction in their classrooms, as below in response to the question: In the questionnaire you agree that interactions between students are important, but in your lesson you did not give opportunity for your students to explain each other answer. Please comments on this.

> "If there is naughty student in the group, sometimes **students fight when they talked to each other**. **They cannot be quiet**. **I think later in the upper grades**; it is possible to have more interaction between students. In these grades, students will also have **more hours to learn math**, so teachers may have more time for longer discussion." [Teacher JKT 1]

> "I think **I have tried to establish interaction between students**. I asked them to share their answers and check each other answer, which is important. In **other topic like geometry or measurement**, sometimes I asked them to work in groups." [Teacher JKT 3]

The transcripts showed that the teachers realized the importance of interaction between students. However, the teachers may think that they have incorporated this aspect in their own practice, but in fact have not (see an example of excerpts in lesson four of teacher JKT 3 in section 7.3.2). They also think that the students are too young to listen to each other, and so horizontal interaction may cause the classroom to become too noisy, which was not desired. It was expressed that when students were in higher grades, they may be more ready to explain to each other their answers, and have more hours to learn math, thus teachers in these grades may provide the opportunity for students to discuss more than they do now.

Content-Based Approach

In relation to the absence of intertwinement in their lessons, teachers gave the following comments in response to the question: Why did you structure the lesson in working unit rather than incorporating different mathematical topics in one lesson?

> "I think it is the standard, as suggested by our curriculum and textbook. **It must be in order.** Let me give you example, in grade 1 students learn place value, then addition and subtraction, then problem solving related to addition and subtraction. After this chapter then they will learn about Geometry topic. So, **students will not get confuse**." [Teacher JKT 2]

> "I like my **students to have a good understanding on a certain concept**, then we go further with another topic. I do not want to sacrifice students understanding for the sake of topic coverage. I will not teach another topic unless I see my students understand the topic they have learnt." [Teacher JKT 3]

The transcripts showed that teachers prefer a content-based approach to the intertwining approach suggested by RME. Firstly, this is to comply with the curriculum and textbook suggestions. Secondly, they are concerned with the students understanding and mastery of the mathematical concept.

8.4 Discussion

The above findings show that the classroom observations and follow up interviews can expose teachers' beliefs better than simply relying on a questionnaire. Comparing teachers' stated beliefs collected from their questionnaire responses, with their classroom practice, consistencies and inconsistencies became apparent. In general, the consistencies include the number of lessons involving contextual problems, and involving the use of models or introduction of some sort of schematization. The teachers also provided a significant amount of lesson time for students to practice, as well as allocated significant time for individual and small group assistance before talking about the problems with the whole class. Besides, the teachers spent a significant amount of lesson time for vertical interaction. This is shown by the time allocated for 'teacher-whole class' and 'teacher-individual student' interaction.

On the other hand, inconsistencies were observed. Contextual problems were mainly given after the introduction of content, the concrete manipulatives used were rather uniform and artificial, and the schemes introduced often lead to the introduction of standard procedures. The intertwinement and horizontal interaction was absent in their lessons. The problems provided during practice sessions were uniform for all students. Teachers did not give much room for students to develop their own strategies as they gave rigorous examples and expected the students to follow their instructions in fixed steps, as well as focused on the correctness of students' answers.

For each teacher, there was actually a little variation in terms of consistency between their teaching practice and the RME ideas. This was in fact influenced by some factors at the individual and classroom levels, such as their attitudinal score (high or low), and class size. This finding is in line with previous studies that suggested teachers' beliefs are one of the factors that play a major role in teachers' instructional decision making and practice (Calderhead, 1996; Thompson, 1984, 1985; Pajares, 1992; Beswick, 2012).

The interviews conducted following the classroom observations have actually allowed this study to better understand teacher thoughts about their questionnaire responses and actions in the classroom. The interview results showed that teachers were concerned the most about the use of concrete objects in their lessons than any other aspect of RME. It seems that they perceived the 'realistic' in RME to mainly be about using 'real' or 'concrete' objects. They believe this aspect of RME can bring joy to the class and learning, as students can play with the manipulatives while learning mathematics. However, while the teachers think that their teaching is different from traditional teaching that teaches formal mathematics directly, in utilizing the concrete teaching aids their method was to introduce a standard method. Moreover, while teachers think the contextual problems and horizontal interaction are good for their students, they had a concern on students' ability to understand the contexts and to listen to one other. Concerning student's ability, the teachers actually realized that their students have different ability levels, but they decided to give the same tasks for all students during the lesson time to be fair to everyone.

Comparing the results of the present study with that of previous studies in research of the consistency between teacher's espoused and enacted beliefs around RME, a considerably lower degree of consistency was found in the present study than in similar studies in the Netherlands or other Western countries (i.e. Verbruggen et al., 2007; Searle and Barmby, 2012). In Verbruggen et al. (2007), for instance, the observed teachers showed support towards RME and most of the classroom episodes in their research was categorized as 'attempted to enact RME', and while there was only a few classroom episodes categorized 'opposite to RME ideas'. In contrast, the present study found the consistency was superficial, and many aspects of the classroom implementation was in conflict with RME ideas.

The TALIS study (OECD, 2009) actually found that while in general there was a significant relationship between teachers' beliefs and the reported practice in many participating countries, in some countries such a relation was not established, or it was even reversed. The TALIS study argued that the relation between teachers' beliefs and practices may have slightly different meanings in different cultures. Teachers in some countries were found to uphold traditional beliefs and teach in a conservative manner, or uphold beliefs that inclined towards a constructivist view and teach in a progressive way. However, in countries that had undergone major curriculum changes (i.e. Malaysia), the teachers showed support towards the constructivist approach, as indicated in their responses to the questionnaire, but their teaching was rather conservative. Similar findings have been revealed in the present study. The three observed PMRI teachers showed high disposition towards RME, but their teaching did not truly reflect what they stated. This implies that the stated belief towards RME may be weak. The teachers who have been immersed in the traditional teaching method during their own education might be greatly influenced by the cultural tradition they experienced, and so this may have taken root in their daily activities. Accordingly, this deeply-embedded tradition was reflected in their teaching naturally.

Moreover, the teachers, through the interview, also realized that there are some limitations to the enactment of some RME ideas in their lessons. Teachers tried to comply as much as with the curriculum and textbook suggestions, but had concerns about students' ability to cope with RME style lessons and exercises. This finding is in line with suggestion from Gravemeijer (2008) who pointed out the importance of supportive teaching sources and students' willingness to learn as two major elements contributing to the effective enactment of RME in the classroom. Arguably, without good learning resources and the support from students, it would be very difficult for teachers, even when they have the right beliefs, to enact an ideal lesson.

In a collectivist society such as Indonesia, where educational practice is heavily centralized, the tendency towards compliant behavior in Javanese tradition might explain why teachers' practice seems to be aligned more with suggestions coming from the curriculum content than from RME ideas, regardless of their beliefs towards RME. This compliance behavior may be an asset, but only when the curriculum and textbook structure and contents are in line with the reform ideas. Teachers would then be likely to follow the suggestions provided by the curriculum and textbook rigorously. However, in cases that the curriculum and textbook structure are inconsistent with the reform ideas, they may put the teachers into a problematic situation in trying to implement the reform ideas, or lead them to interpret the ideas superficially.

Furthermore, teachers may also think that students are not yet able to cope with their teaching, as they are *durung ngerti* (not yet able to undesrtand). Teachers may think that exploration of contextual problems or horizontal interaction is good, but they might not be appropriate for their students. The exploration of contextual problems as a starting point is seen as too complex and difficult for young students who still need a lot of guidance. Besides, during the discussion students may be disruptive and distract each other. Teachers also tried to avoid activities such as integrating different mathematical topics in one lesson, as it is regarded as a potential source of confusion for the students. This behavior may actually be related to the fact that Javanese parents (equitable to teachers at school) often heavily protect their children from frustation (Geertz, 1961).

Finally, this chapter has shown that the combination of the curriculum and textbook expectations, students' responses, and teacher beliefs have contributed to the inconsistencies found. However, given these schools are among the pilot schools for PMRI movement, the related stakeholders should have anticipated some technical obstacles. Even if they had not, the obstacles are temporary, while those rooted in culture are deeply embedded in everyday life interactions of the teachers, and hence may be permanent.

Chapter 9 – Discussion and Conclusion

Chapter five, six, seven, and eight presented the data analysis and findings of the present study. With these findings, the first part of this chapter discusses the features of RME reflected in various aspects of mathematics education in Indonesia, and what has changed in the process. It also interprets how to explain the alignments and divergences found. The second part of this chapter presents the conclusion of the thesis. It summarizes the major findings of the study to answer the research questions, then presents the contributions and implications of the study. Finally is a discussion of the limitations and recommendations for future research.

9.1 Discussion

With the findings on the features of RME reflected in various aspects of mathematics education in Indonesia, and changes in the adoption process, this study looks for the factors that can account for and explain the findings. In particular, an explanation from a cultural perpective is explored. Therefore, the description in this section starts with a summary of the findings of the implementation of each RME principle presented in the previous chapters, and evidence from the data. The findings are then related to the Indonesian cultural context rooted in the Javanese tradition, as described in chapter three, for explanations. Accordingly, alignments and divergences between the findings and the Indonesian culture are explored and characterized.

9.1.1 Summary of Major Findings

The major findings in this study are summarized in table 9.1, and the evidence from data sources are discussed below.

RME Principles	Findings in This Study	
	Consistency	Inconsistency
Reality Principle	1.1 Use of contextual problems	1.2 Contextual problems as application rather than as a source for learning 1.3 Use of bare number problems
Level Principle	2.1 Concrete teaching aids, models and schematization	2.2 Uniform and artificial models 2.3 Single Solution method
Activity Principle	3.1 Active learners 3.2 Joyful learning 3.3 Individual task	3.4 Content – oriented lessons 3.5 Uniform tasks
Guidance Principle	4.1 Individual and whole class guidance	4.2 Rigorous examples and standard methods 4.3 Result-oriented lessons
Interactivity Principle	5.1 Teacher – whole class interaction; Teacher – individual student interaction	5.2 No explanation of Answer 5.3 Absence of 'individual student – teacher' interaction 5.4 Absence of horizontal interaction
Intertwinement Principle	-	6.1 Topic-based lesson 6.2 Absence of exploration/ intertwining activities

Table 9.1 Summary of major findings

1. Reality Principle

The Indonesian primary mathematics curriculum suggests contextual problems to be used both as a source of learning and as a field of application of the mathematics content being covered. In PMRI textbooks, 22% of tasks were situated in a real world context. Yet, the curriculum suggests problem solving is a different competency to be taught at the end of a topic, and some contextual problems in the PMRI textbook were found to be as inappropriate (i.e. money contexts).

As shown in the findings of chapter six, the PMRI teachers showed a high intention to use the RME approach in general, and in the use of contextual problems in particular. From the classroom observations, four of the twelve PMRI lessons were found to utilize contextual problems as a source of learning, and six out of twelve lessons utilized them as the application of the content. But at the same time, ten out of twelve lessons also provided bare number problems for students.

In the interviews some teachers explained that while they agree that contextual problems are meaningful, they think it is too difficult for young students who are still developing their language capabilities. On the other hand, students may not cope with their learning if they are provided a problem with context before content has been introduced. Without a strong content mastery, it is difficult for students to solve the given problem.

2. Level Principle

In relation to the level principle, the Indonesian curriculum encouraged the use of models and schemes when teaching and learning mathematics. Many tasks (35%) in the PMRI textbook was also presented with models or schemes. In the interview and during the observations, teachers were found to be in favor of this feature of RME. However, as can be seen from the excerpts presented in chapter seven, the models utilized are uniform and artificial, and the schemes or methods utilized required students to follow fixed steps rigorously (working step by step), resulting in students learning through a single solution method.

3. Activity Principle

Although not significant, the PMRI textbook provide a few tasks that allow students to learn through an ‘own production’ process. From the results of the survey, teachers had the intention to give students an opportunity to be active learners, as can be seen from the high mean of the SDM factor (M = 3.76). From the interviews, it was evident that teachers intended to give a joyful learning experience in their lessons, and provide opportunities for their students to actively participate in the learning process.

In the classrooms, PMRI teachers allocated a significant amount of time for practicing (31.43%). However, the focus of the lessons was mainly on introducing content (37.14%), and the exploration or 'doing mathematics' activities were barely observed. Furthermore, while this feature of RME suggests teachers to treat students as individuals who are given opportunities to build their personal knowledge, the tasks provided for all students are the same. There was no differentiation of tasks provided for students with different abilities.

4. Guidance Principle

The Indonesian curriculum highlights the importance for teachers to guide students to gradually mastering the mathematical concepts. In the survey, the PMRI teachers actually had a generally low guidance factor (M = 2.96). Within this factor, the items were associated with the teacher's intention to use a standard method, to give rigorous examples, putting a high value on the right answer, to provide tasks in a formal manner, and to direct the lesson strictly.

During the classroom observations, while two teachers observed in this study (teacher JKT 2 and 3) had a high score in this factor, the implementation was similar to that with low scores in the survey (teacher JKT 1). Ten out of twelve lessons in PMRI classrooms required students to follow teachers' instruction rigorously. Seven out of twelve lessons also introduced standard methods. For the 'practice' sessions, the teachers were observed providing assistance while students were completing tasks (individual or group assistance 20.09%, and class contact 11.34%), but the teacher's focus during these contacts was often on checking if students had a correct answer. From the teacher interviews, it was also found that all teachers agreed that working sample problems, or giving examples and solutions, are very important in their mathematics lessons.

5. Interactivity Principle

From the survey results, the PMRI teachers actually have a moderate interactivity factor (M = 3.26). In the classrooms, the method of interaction in PMRI classrooms was mostly in the form of 'teacher-whole class' interaction (25.9%), and 'teacher-individual student' interaction (30.5%). Students did not show initiative to ask questions or begin a discussion ('individual student-teacher' interaction was 0%), and no interaction between the students was observed.

From the teacher interview transcripts, it was also found that while teachers think that interaction between students is important, teachers thought students are too young and immature to have a discussion, and so this teaching strategy may cause students to distract each other.

6. Intertwinement

The Indonesian curriculum suggests learning mathematics is to have a topic-based structure. The lessons in PMRI classrooms were structured by working unit. None of them incorporated connecting mathematical concepts from other units. During the interview, teachers mentioned that they prefer self-contained units in order to give the opportunity for their students to gain mastery of one unit before they are introduced to another. It was felt that intertwining topics may make students confused.

9.1.2 The Adaptation of RME and Indonesian Culture

The implementation of each RME principle presented above was related to the Javanese cultural features. This was done to explore explanations for convergences and divergences between Indonesian and Dutch RME practice. The results of this are summarized in table 9.2 below:

Javanese Cultural Values	**Influence on the implementation of RME identified in this study (table 9.1)**
Collectivism Roots a. Learning as individual and learning together b. Limited personal interest	 **Alignment** 3.1 Active learners 3.3 Individual task 4.1 Individual and whole class guidance 5.1 Teacher-whole class interaction; Teacher-individual student interaction Divergence 3.5 Uniform tasks
The Avoidance of Conflicts and Indirect Communication	Divergence 5.4 Absence of horizontal interaction
Expectation on Compliance Behavior	Divergence 2.3 Single Solution method 4.2 Rigorous examples and standard methods 4.3 Result-oriented lessons
Guru- Student Relationship	Divergence 4.2 Rigorous examples and standard methods 4.3 Result-oriented lessons 5.2 No explanation of Answer 5.3 Absence of 'individual student-teacher' interaction
Rote Learning	Divergence 1.2 Contextual problems as application rather than as a source for learning 4.2 Rigorous examples and standard methods 6.2 Absence of exploration/ intertwining activities
Indulgent behavior to the children	**Alignment** 2.1 Concrete teaching aids, models and schematization 3.2 Joyful learning

Table 9.2 Influences of Javanese cultural values on the implementation of RME identified in this study

9.1.2.1 Collectivism Roots

The findings 4.1 and 5.1, the whole class guidance and interaction was dominant, might be explained through the importance of togetherness (*guyub*) in the Javanese community. Javanese culture basically has social orientation or collectivism point of view. Learning together, in a whole class setting, can be a way to educate students about collectivity and solidarity, which is stressed in Javanese culture. An extensive application of the form of classical teaching and learning in Indonesian classrooms has been acknowledged and considered to have influenced learning forms in Indonesian schools today (Chang et al., 2014).

In order to contribute to the community as an individual, one also has a responsibility to develop herself. Common Indonesian folk sayings about self-responsibility to gain knowledge, such as cleverness based on diligence (*rajin pangkal pandai*) are reflected in classroom practice. According to Swadener and Soedjadi (1988), the implied duty of all education sectors, including mathematics education, is to develop students' intelligence and attitudes in order to enable them to make constructive contributions to Indonesian society, as presented in the Outlines of State Policy (GBHN, 1983, cited in Swadener and Soedjadi, 1988, p.195-196):

> "National education is to be based on the *Pancasila* principles in order to enhance the devotion to the One God, improving intelligence and skills, strengthen reality, develop personality, and heighten the spirit of patriotism and love to the homeland. This is to develop citizens imbued with the ideal of construction, able to develop collective and self-reliance, and possess a sense of collective responsibility in building the nation of Indonesia."

The findings 3.1, that teachers intended to give students the opportunity to be active learners, and 4.1, that teachers provided individual assistance prior to the whole-class interaction during practice, and 5.1, that 'teacher-individual student' interaction was dominant in the whole-class setting, can be explained by this aspect of Javanese culture.

While the above shows that the collaborative aspect of RME aligns with the collectivist root of Javanese culture, in other regards, Javanese collectivism conflicts with some highly individualist aspects of RME. Accordingly, Javanese collectivism may be attributed to the uniform nature of the PMRI classrooms and textbooks, as discussed in section 3.5 (no differentiation of tasks for students with different abilities). In Indonesian culture, the predominant belief of fairness enacted in education means that students should receive the same educational standard (Swadener and Soedjadi, 1988). This is expressed in the Javanese saying, '*titik podo kroso*', this emphasizes the importance of an equal share among family and society members, although it may cause everyone to receive an insignificant part. If parents or older people would like to give an additional share from other resources to individual family members in need, they should not show it in public or they may invite jealousy from others.

Thus, giving tasks with different levels of difficulty during the lesson might be seen as inappropriate because this is considered to be unfair for some students, and thus will affect the harmony of the classroom. A remedial or enrichment lesson may be given, but in private in after school hours. In RME, however, uniformity of learning is not desired. As far as RME is concerned, it is encouraged that students learn at their own level, and it is unnecessary for all students to simultaneously follow the same learning path.

9.1.2.2 The Avoidance of Conflict and Indirect Communication

The finding 5.4, that horizontal interactions were absent, can be explained by the strong emphasis on *rukun* that characterizes a typical Javanese person as avoiding social and personal conflict. The absence of direct interaction between students in the PMRI classrooms can be anticipated because expressing direct opposition is not socially acceptable in Indonesian classrooms (Farver et al., 1997). In Javanese society, parents teach their children to keep relationships harmonious with others (*rukun*). This serves as the basic guidance for social interaction. Parents also discourage their children to disagree, and they consequently aspire towards being very controlled and having a calm state of mind. In cases where they have a different opinion from others, Javanese may want to have a conversation in private, not in public. In this regard, an open conflict should not occur in any situation.

On the other hand, the Interactivity principle in RME suggests students should openly express their opinion, give and receive criticism with respect to others, and support their explanation with argument and justification. While this feature is in line with Dutch culture which resolves conflicts by compromise and direct communication, it diverges from Javanese culture as described above.

9.1.2.3 Expectation on Compliance Behavior

The findings 2.3 (single solution method), finding 4.2 (rigorous examples and standard methods), and finding 4.3 (result-oriented lessons) show how teachers stressed the rule-following method in their lessons. Teachers' efforts to emphasize the importance of this aspect may reflect the expectation of compliance behavior in Javanese culture. In Javanese tradition, one is compelled to respect and realize the need for norms. Norms allow one to distinguish good from bad, and right from wrong. This perception however is not only from one's own perspective, but rather it should also be seen from the lens of the larger society as a whole. To be consistent with the duty of developing students' intelligence and attitude, to enable them to make constructive contributions to Indonesian society, it is important to nurture learners' 'personality that should be directed toward achieving harmony within oneself and society (Swadener and Soedjadi, 1988, p.199)

> "For Indonesian education this means being consistent with the principles of Pancasila. Students should become citizens with a positive personality, be self-directed, loyal, and prepared to carry out activities consistent with the principles valued by society. Efforts directed toward shaping such a person proceed through the development of philosophical values which start with the forming of habits. These habits are: (a) realizing the need for and respecting the existence of norms, (b) consideration of the consequences of decisions before the decisions are made, and (c) reducing tension caused by contradictions within oneself or between oneself and the environment."

The norms described above can be in the form of rules, certain procedures, or regulations that one has to follow. Thus rigorously following rules (*runtut*) is as an effort to make sure that the decision has been made after considering the consequences of other steps. In an individualist society such as the Netherlands, however, this kind of fixed rules adhering and control is disliked. Therefore, introducing fixed procedures and standard methods can be seen as not in line with the RME guidance principle, yet this aspect was seen as important in Indonesia.

9.1.2.4 Guru-Student Relationship

Finding 4.2 (rigorous examples and prevalent use of standard methods) and finding 4.3 (teacher often focused on checking the correctness of students' answers) might be explained by the fact that Guru is often regarded as a source of learning and someone that is to be followed and listened. Thus, giving examples can be seen as a way to show that the teacher is knowleadgable. Furthermore, checking if student's answers are correct during practicng sessions can be a way to maintain teachers' authority.

In relation to finding 5.2, in which the teacher questioning method only requires a short student response, it may also relate to the perspective that the teachers is the source of learning, and therefore it is their role to explain what students are to learn. As a learner that is not yet knowleadgable, on the other hand, students may not be able to articulate their answer very well.

In relation to finding 5.3, in which students did not demonstrate an initiative to ask a question, this may also relate to the classic Guru-student relationship that exists in the society. Teachers and students have a large power distance and therefore teachers are 'inaccessible'. Therefore, a student posing a question to the teacher is uncommonly in Indonesian classrooms. In contrast, in a society a with low power distance index, such as the Netherlands, students may feel free to raise questions or to argue with their peers, and even with their teacher.

9.1.2.5 Rote Learning

In relation to finding 1.2, (contextual problems mainly provided as application), finding 6.2 (exploration activities were absent), the emphasis on rote learning in Indonesian education as pointed out by Siegel (1986) may explain the findings. Siegel (1986, p.148) noted that in the Indonesian educational setting "whatever children learn turns out to be not their discovery but the property of 'tradition', that is something already formulated". This means that Indonesian people believe that many things in life are pre-defined and given. Therefore, in gaining a classic knowledge such as mathematics, it is unnecessary for them to question its truth (i.e. by exploration or inquiry activities). This aspect, therefore, is considered to diverge from the RME ideas that suggest the implementation experienced-based inquiry activities and intertwinement of various mathematical topics.

Besides, the expectation to the act of *runtut* may also explain finding 4.2 (rigorous examples and use of standard methods). According to *runtut*, there must be no stone unturned for paying respect to any step on the way toward goal. Therefore, rigorous examples and fixed procedures or methods may serve as guidance to help students to enacting this expression. In contrast, Dutch people emphasis the importance of meaningful learning rather than concept mastery that is gained through rote learning.

9.1.2.6 Indulgent Behavior towards Children

The last aspect of Javanese culture discussed here is indulgent behavior towards children. Geertz (1961) found that Javanese parents were generally very indulgent towards young children. Therefore, findings 2.1 and 3.2, in which teachers showed an intention to provide joyful learning was in line with this cultural aspect. As teachers stated in the interview, the aim of using concrete aids was both to provide joyful and meaningful learning. However, the nature of the model used was more artificial than meaningful (finding 2.2). It was observed that students did not utilize the suggested models (straws) to solve the given addition tasks. They were rather playing with the straws. As pointed out by Leung (2001), the simplification of the term 'joyful learning' was often misleading in some countries, and the activities might not be encouraging students to do 'real math', as expected.

While the focus of the present study is the influence of culture on the adaptation of RME in Indonesia, it is evident from the discussions above that the cultural explanation may not be adequate to explain all the findings (such as finding 1.3, finding 2.2, finding 3.4 and finding 6.1). Therefore, in addition cultural factors this study explores other factors, including the social dimension of mathematics education and the stage of development of RME in Indonesia.

9.1.3 Other Significant Factors

In addition to culture, this study explored some factors that might be attributed to the findings. This study utilizes the social dimension of mathematics education framework by Bishop (1988), as well as discusses the stage of RME development in Indonesia.

9.1.3.1 The Social Dimension of Mathematics Education

As presented in chapter two, Bishop (1988) discussed the cultural dimension of mathematics education, along with the societal, institutional, and pedagogical dimensions as among the influential factors of mathematics education practice in a particular country or region. This is discussed below:

(a) The Level of the Classroom

In relation to the individualist aspect of RME, such as providing individualized learning path for students with different abilities, one may argue that the typical large class size of a classroom (such as that in Indonesia) would inhibit a teacher from enacting this idea. It is likely difficult for a teacher to take care of the progress of students with different abilities in a large class if they are working on different tasks or learning, through different paths or levels. As shown in the interview results in chapter eight, some teachers also had a concern about this classroom aspect. Moreover, some variations of teachers' implementation of RME may relate to the teachers' attitudes towards RME and their background factors. Some teachers may be more (or less) enthusiast than others and this attitude caused some variations in the enactment of RME.

(b) Institutional - the Institution (school) Level.

In regard to the findings related to the use of contextual problems in the lessons, the use of models that are rather uniform and artificial, and the absence of ‘making connections’ activities, one may argue that this can be explained by the availability of teaching resources, rather than by culture. As discussed in chapter seven, while teachers in Utrecht might have advantages from the availability of textbooks that were developed based on RME, and various teaching aids provided by schools, the Indonesian teachers might be limited by the absence of this aspect in their context of teaching. For example, to enact the idea of using concrete teaching aids in introducing the addition and subtraction topic, the teachers in Jakarta asked students to bring some bundles of straws by their own. This resulted in the use of a uniform and artificial use of the model. These models were not found to be useful or help students to scaffold their learning, instead they were used for the sake of ‘using concrete teaching aids’ in an RME lesson. On the other hand, schools in Utrecht are equipped with great sources of manipulatives (such as arithmetic racks, strings of beads, etc) that students can choose based on their needs.

Besides, the Dutch teachers may also have advantages from the availability of a smart-board, as well as the students’ individual textbook and workbook. In Indonesia, as mentioned in chapter seven, during the introduction of content or a practicing activity, teachers mainly used the white board or distributed some worksheets containing tasks for students to work on. With great teaching resources, teachers in Utrecht can spend less time preparing an exploration activity that is often already presented in the textbook. In contrast, the absence of similar supports in Indonesian schools may influence teachers when enacting this aspect of RME, or the differentiated tasks discussed above, as they have to expel more effort, resulting in increasing their already high workload.

(c) Societal - the Level of Society (Education System)

The prevalent use of 'bare number problems' during individual tasks (finding 1.3) might be due to differences in the assessment method in Indonesia and the Netherlands. In the Netherlands, the items on the summative assessment of mathematics in grade one are presented as contextual problems (i.e. with pictures and stories). In Indonesia, the items are often presented as simple bare number problems that require a single answer (in the form of multiple choice). Here, teachers in the two places might prepare their students for the examination purpose as well.

Another aspect that might also explain the differences found in the present study was the limitation of time allocation. Some teachers might actually excuse the lack of interaction in their classrooms due to time constraints. In Indonesian schools, the time allocation for school time in lower primary grades is around 26 hours per week for all lessons. On average, schools allocate two or three hours for mathematics a week in grade one; which is usually distributed over two or three days. The remaining hours were allocated for religious studies, civic education, language, art, and physical education. In the Netherlands, students in grade one (*groep 3*) learn mathematics one hour every school day. In this system, students in low grades learn language, math, arts, science and physical education with a total of around 22 hours per week. Given the total hours in Indonesian school is more than that in a Dutch school, the Indonesian government did not allocate more time for mathematics. There must be a reason for the priority of teaching other subjects such as religious and civic education since the early years of school.

Moreover, as aforementioned, the content-based approach adopted in the national curriculum and the centralized decision making of the contents to be taught was not in line with the RME intertwinement principle. Thus, the teacher's emphasis on teaching the mathematical content, and the lessons that are structured in the working unit (finding 3.4 and finding 6.1) might be merely an effort to comply with the curriculum suggestions. In the Netherlands, on the other hand, mathematics and its organization in the curriculum are flexible. There is no centralized decision making of what contents should be taught in each semester or school year. Here, the cognitive development of students tends to be more important for the Dutch educators, than the mastery of the mathematical contents itself. Furthermore, the fact that the presentation and some contents of the PMRI textbook was not well matched with the expectations set by the national curriculum might also put the teachers in a problematic situation. For instance, the topic of addition and subtraction of two digit numbers was not covered by the PMRI textbook in grade one, but is mandated by the curriculum. Therefore, in their efforts to look for inspiration on how to teach the mandated contents, teachers use the national (BSE) textbook, that has many inconsistencies with RME principles.

9.1.3.2 Stage of RME Development

In the discussion of influential factors on how RME has been adapted in Indonesia, one may suggest that the different stages of RME development in Indonesia and the Netherlands should not be ignored. Given that RME has taken root in the Dutch education system, but currently not in the Indonesian system, it is foreseeable that in the coming years Indonesian teachers may enact RME in a similar way to the Dutch. This perspective might be supported by the fact that RME itself evolved in a round of educational reform in the late of 1960s in a reaction to the mechanistic and traditional teaching approach popular during that era (Treffers, 1987).

In the same spirit, if the mathematics educators in Indonesia also consistently develop PMRI, as the Dutch educators did with RME, someday realistic methods will also be rooted in Indonesian education. However, as described by Gravemeijer and Terwel (2000), today's RME was greatly influenced by the Dutch educational *Didaktik* tradition. When RME is transferred to a system without this tradition, such as Indonesia, it may not develop similarly.

Taking another extreme, one may argue, that after sometime, the educational practice borrowed from a foreign system may fall into a cycle of "early enthusiasm, widespread dissemination, subsequent disappointment and eventual decline" (Slavin, 1989, p. 752). In the view that PMRI has been developed for more than a decade in Indonesia, the teachers might not be as enthusiast as before when they were first introduced to it and received full support from other stakeholders. They may also find that there are many factors which hinder classroom implementation. As shown, these include expectations in the curriculum, school support, and feedback from students and their peers. The mismatch between the reform expectation and these contextual aspects may cause teachers who had a high passion to implement realistic styled education to go back to the conservative way of teaching that is rooted in their daily activities.

9.1.4 Summary

The above discussion showed that some findings shown in table 9.1 might be explained by a combination of factors operating at the classroom, institutional, societal, and cultural levels, as well as the stage of RME development in Indonesia, rather than just by cultural factor alone. In fact, while some factors are universal to any borrowing practice, some of these factors are influenced by the culture as well. For instance, in terms of the stage of RME development in Indonesia, the absence of a *Didaktik* tradition in the

Indonesian education system may cause RME to develop differently than it did in the Netherlands. Given that the conditions at these levels might also be encountered in any borrowing practice of other countries, the discussion in section 9.1.2 has shown how the Indonesian-Javanese culture gives RME unique characteristics after adoptiony.

9.2 Conclusion

9.2.1 Answers to Research Questions

As mentioned in chapter one, the present research has examined RME adoption in Indonesia, and how it has departed from it's original, Dutch form. From the discussion in the last four chapters, and in section 9.1 above, this study has discussed the answers to the research questions, as summarized below:

(1) How RME principles are reflected in the Indonesian exemplary curriculum materials, and how does this differ from that in the Netherlands?

RME principles reflected in the Indonesian curriculum were limited by the content-based approach applied, as well as by the centralized decision making regarding the contents to be covered. The RME principles adopted include the use of contextual problems to start the lesson, utilization of models and schemes, developing the communication ability of students, and establishing relationships between mathematical concepts during lessons. However, due to the content-based approach adopted in the curriculum, it suggests exploration and problem solving activities should be provided only after concept mastery has been established, rather than as part of the concept mastery itself.

At the textbook level, many ideas in the BSE textbook were found to be inconsistent with RME. This includes a lack of contextual problems and schemes or models, the prevalent use of rigorous examples and rules, the absence of explorative activities, and the separation between concept mastery and concept application, which was put at the end of each chapter. As for the PMRI textbook, it has adopted most features of the Dutch realistic textbook. The contextual problems presented were adapted to an Indonesian context, instead of directly copying those from the Dutch context. However, task differentiation for students, one of features of the Dutch realistic textbook, was absent from the PMRI textbook.

(2) What attitudes towards teaching and learning mathematics do the PMRI teachers uphold? How consistent are their attitudes with the RME principles? How are the attitudes different from that of the Dutch teachers??

In terms of teachers' attitudes, there were four factors associated with teachers' attitudes towards RME extracted in the survey. This includes teacher intention towards realistic education (ITN), guidance provided for the students (GDN), opportunity given for students' self-development (SDM), and interactivity in the classroom (INT). From the results, the mean score shows that of the PMRI teachers who participated in the survey, they generally showed teaching beliefs that are consistent with the RME (M = 3.67). Particularly, their intention towards implementing RME teaching styles into their lessons had the highest mean score among other factors (M = 4.25). While their attitude towards the GDN factor had the lowest mean score (M = 2.96). The other two factors, SDM and INT, have mean scores of 3.56 and 3.26, respectively.

Comparing this result to a similar study conducted earlier in the Netherlands, the two datasets extracted a different number of factors, which actually shows how teachers in the two places have different concerns of what is regarded as RME. In the Dutch data, the teachers' responses form a pattern associated with three groups of items, in which each group was related to the most descriptive factor; i.e. teacher intention, lesson structure, and student opportunity. For the same items, the PMRI teachers tended to respond differently. Their responses showed patterns to the four factors described above. For some items identified within the guidance and interactivity principle in the present study, the PMRI teachers were also found to have a substantialy lower score than their Dutch counterparts

(3) How do the PMRI teachers implement RME principles in their classrooms? How is the implementation different from that of the Dutch teachers?

There were some similarities observed in the Jakarta and Utrecht lessons that had intended to enact RME ideas. In terms of lesson structure, teachers in Jakarta and Utrecht spent significant lesson time for the introduction of materials, and for students to practice. Teachers also actively provided necessary assistance for students during the practice activity. In terms of method of interaction, it was observed that a significant amount of the lesson time in the two places was devoted to students working individually, while during the whole class setting, the 'teacher-whole class' interaction and 'teacher-individual student' interaction dominated the classroom. Teachers in both places also provided contextual problems and concrete teaching aids, as well as introducing schemes, tables, and diagrams to help students grasp the lesson concept.

Despite these similarities, there were significant differences in terms of the use of contexts, models and schemes, the type of individual tasks, the interaction methods, as well as the enactment of the intertwinement principle. While it is reasonable to expect to observe more consistency in the implementation of RME in Utrecht, the implementation of RME in Jakarta has departed from its original form significantly.

In the Dutch classrooms, the contextual problems selected were found to be tailored to students' interest and were utilized as a source of learning. In Jakarta, the contextual problems were given during the 'practicing' session, after students had learnt the content. In Utrecht, there were various models and schemes introduced. In Jakarta, the models and schemes were uniform, and lead to the introduction of a standard or fixed method. Differentiated tasks were provided for students with different ability levels in Utrecht, while the tasks in Jakarta were uniform for all students, regardless their ability. The Dutch classrooms were also more open to students' engagement and promoted social interaction among students. In contrast, in the Jakarta classrooms lessons lacked horizontal interaction. Lastly, while the teachers in Utrecht incorporated various mathematical topics into one lesson, the teachers in Jakarta preferred to organize their lessons strictly in line with the units, using a content-based approach.

(4) How are the PMRI teachers' classroom practices consistent with their attitudes to teaching mathematics?

Comparing the teachers' classroom practice in Jakarta with their stated beliefs, the present study found consistencies and inconsistencies. The progressive beliefs reported by the PMRI teachers might not be strong as they were not fully applied to their teaching. On the other hand, through the interview, teachers also realized that students' responses are among the limitations to the enactment of RME in their lessons. For example, teachers think that contextual problems and horizontal interaction are good, however they see implementation to be difficult for their students. Teachers thought that sometimes students could not cope with their teaching. Therefore, they may give contextual problems only after students have a good mastery of the content, or conduct horizontal interaction only in higher grades. Teachers also thought that students need rigorous examples and guidance when learning mathematics. Other than students' response, the curriculum, textbook and school support were also among the factors that teachers were most concerned about when making their instructional decisions.

(5) What factors can account for the findings? How does culture influence the implementation of RME in Indonesia?

This study found that most of the findings in this study can be explained by the alignments and divergences between RME and Indonesian-Javanese culture. The collectivist feature of Javanese culture was found to align with the idea of, 'learning both as individual and through social process', while the indulgent attitude of Javanese people towards young children supports the idea of joyful learning in RME. Yet, there are many aspects of Javanese culture that diverged from the RME ideas, and have driven the inconsistencies identified in this study. The indirect communication preferred among Indonesian people restricted the take-up of horizontal interaction, while the limitations of individual interest and the preference for uniformity in Javanese culture hindered the enactment of individualized learning in PMRI classrooms. The expectation for compliance, as well as the classic Guru-student relationship, in this culture caused teachers to have an inappropriate interpretation of how to carry out the guidance and vertical interaction principles in RME. Finally, the rote learning approach in Javanese culture hindered the intertwining and exploration features of RME. Detail of these alignments and divergences are summarized in table 9.2.

In addition to culture, some findings can be explained by the factors at the classroom, institutional, or societal levels, as well as the stage of RME development in Indonesia. At the classroom level, the differences in class size in Indonesia and the Netherlands affected how teachers structured and designed their lessons and activities. At the school level, the availability of teaching aids and resources in the Indonesian and Dutch schools might also influence how the teachers enacted inquiry learning, or utilized models and schemes in their lessons. At the societal level, the differences in assessment method, time allocation for mathematics lesson, and the curriculum structure might also influence teachers when implementing RME in the classroom.

Yet while some of these factors are rather universal for any borrowing practice, some of these material and institutional factors are influenced by Indonesian culture as well. On the other hand, while these aspects are temporary and changeable, culture is deeply embedded in everyday life interactions of the teachers, and hence could endure indefinitely. Given the conditions at these levels may also be encountered in any borrowing practice in other countries, the Indonesian-Javanese culture gives RME unique characteristics in Indonesia.

9.2.2 Contribution of the Study

There are two major contributions of this study towards the gaps of knowledge in the existing literatures. Firstly, the current literatures on the influence of culture towards educational borrowing practice are mostly in the form of theoretical review and analysis (Walker and Dimmock, 2000; Phuong – Mai, Terlouw and Pilot, 2006; Phuong – Mai, Elliot, Terlouw and Pilot, 2009). There are a few empirical studies have been conducted to investigate this phenomenon. Illustrated within the context of adaptation of RME in Indonesia, the findings in this study have shown how culture has influenced the extents to which a certain educational theory or practice can be adopted in a foreign setting. This study shows that it is the culture, along with other contextual factors, that has greatly influenced the extents to which RME ideas can be accepted and integrated in the Indonesian mathematics education. Given RME has also been transferred to some other countries, the extents to which

RME can be adapted in each respective culture is likely to be unique rather than universal.

Secondly, this study discusses the characteristics of Indonesian educational culture that is rooted from Javanese tradition. A discussion on the compatibility and incompatibility between the Javanese tradition and the educational approach that was developed in Western culture, such as RME, was presented. This discussion may contribute to fill in the gap of knowledge on the Indonesian educational culture, where the general international audience is so ignorant about.

9.2.3 Implication of the Study

In this section, the theoretical, methodological and practical implications of the present study are discussed.

9.2.3.1 Theoretical Implication

This study has reinforced previous findings (i.e. Phuong – Mai et al., 2006; Phuong-Mai et al., 2009; Hertz-Lazarowitz and Zelniker, 1995; Vu Thu Hang et al., 2015) that suggest a certain instructional approach or educational method might not be truly universal when implemented across cultures. The present study has shown that educators and teachers in different cultural contexts might interpret and enact an approach like RME differently. Therefore, in any adaptation practice, the significance of the contextual and cultural factors between the countries involved should not be overlooked. This means that to learn from others is more effective than to borrow from others.

Moreover, the focus of transference of practice reported in previous studies was mostly at the appropriation stage, including the preparation of teachers' development programs and developing learning materials with the local contexts (Hadi, 2012; Romberg 2001). This approach was based on the assumption that teachers will change their beliefs through various supportive contexts, as shown by a broad research literature, and eventually change their teaching practice (Szydlik, Szydlik and Benson, 2003; Bobis et al., 2016; Potari and Georgiadou–Kabouridis, 2009). In the present study however, it was revealed that even when the educators and teachers have been extensively involved in various introduction and development programs, teachers still do not fully change their traditional teaching beliefs that are rooted in their cultural outlook. This might also result in a superficial understanding of the important features of the proposed instructional theory, as these are often regarded as seemingly culturally-neutral interventions. Therefore, while it is true that in facilitating teachers' change the teacher educators and related stakeholders should continuously suggest different alternatives, they may want to conduct the teacher training with reference to culture and explicitly discuss with the teachers about the cultural barriers to the implementation of the offered methods.

In relation to the factors that influence teacher practice, previous studies suggest teacher attitudes and beliefs are one of the most influential factors to their actual teaching (Calderhead, 1996; Thompson, 1984, 1985; Pajares, 1992; Beswick, 2012). In the present study, the PMRI teachers had a high disposition towards RME but their implementation did not fully reflect that dispostion as expressed in the questionnaire. This indicates that there are many other factors other than attitudes affecting teachers' instructional decision making. For instance, in a country that applies a centralized curriculum, such as Indonesia, then the contents to be covered mandated by the curriculum, and the methods suggested in the textbook, will greatly influence how the actual teaching is conducted, regardless of teacher beliefs.

Furthermore, as reported in the current literature, more similarities than differences were found in terms of the aim and objectives of mathematics education in different countries (i.e. Chen and Leung, 2013). In this study, it was found that even when the general descriptions of the curriculum look quite similar, different emphasizes were placed. For example, both the Indonesian and Dutch primary mathematics curricula placed high importance on providing opportunities for students to work with contextual problems and developing their problem solving abilities. However, the Dutch curriculum put more emphasis on the cognitive and personal development of the learners, while the Indonesian curriculum emphasized the mastery of mathematical contents more.

9.2.3.2 Methodological Implication

The present study addresses limitations pointed out by previous comparative researchers and research on educational borrowing (Ebaguin and Stephens, 2014; Kusanagi, 2014; Liu and Feng, 2015). While previous studies have only used one data collection method, focusing on one aspect of education, or only studied the phenomenon within one context, the present study utilized various methods to better understand the phenomenon of RME adaptation in various aspects of Indonesian mathematics education. Furthermore, this study compared the findings to similar aspects in the Netherlands. The classroom observations in the two sites (Jakarta and Utrecht) were also conducted simultaneously in the same academic year and for several consecutive number of lessons. Contrasting the findings with the current practice in its country of origin has also allowed this study to get a more holistic picture of the influence of culture towards such transfer practice.

9.2.3.3 Practical Implication

This study has practical implications for teaching mathematics Indonesia. Firstly, this study informs the PMRI teams on the further development of RME in Indonesia. In the teacher education program and ongoing RME workshops, or in RME conferences, the PMRI experts might also openly and explicitly address the mismatches between RME and Indonesian culture identified by this study. In relation to the four stages of educational borrowing proposed by Phillips and Ochs (2003), the Indonesian PMRI experts may want to learn from the findings of this study to evaluate and reflect upon the implementation of PMRI as it enters its institutionalization phase.

Secondly, nowadays Indonesian educators and practitioners have attempted to find an effective educational theory and practice that is culturally relevant to their society and cultural beliefs. However, instead of developing one on their own, the educators looked to other systems for reference. In this regard, the current study shows how the imported theory may not be entirely compatible with Indonesian educational culture and values.

Thirdly, the classroom study in Jakarta can inform the related stakeholders to follow up the condition of their materials and take further action to develop them. The curriculum and textbook developers may learn what support teachers need in order to effectively enact the curriculum expectations. For example, if the textbook gives too many examples and too much guidance, with very few problem-solving tasks, teachers will find it more difficult to develop students' problem solving abilities. Moreover, recommending a thematic approach to deliver a content–oriented mathematics curriculum may bring confusion to the teachers and textbook developers. As a result, the textbook is presented in a content-based manner, with a theme that may not be related to the topics being discussed. In fact, the teachers were found to reach the mathematical content objectives of the particular thematic unit or lesson entirely through a content-based lesson style.

Finally, this study has practical implications for the international audience. This study has shown that 'one size does not fit all'. One should always be humble to learn from others, but it is also important to understand whether the borrowed practice can neatly fit within the educational and wider culture of the adoptee context. On the other hand, the responsibility of educators from the approach's home country does not end at working with their colleagues in the adapting country to disseminate the approach, but extends to being aware of the agendas in such a collaboration, and empowering their colleagues to identify what is best for that particular local context (instead of copying theirs). As Atweh and Clarkson (2005, p. 112) have said, "Hence, international aid should not be based on transference of know-how but on capacity building of local educators to empower them to generate their own knowledge and expertise in developing areas of research and curriculum development for their own condition".

9.2.4 Limitation of the Study

There are three limitations identified for this study. Firstly, the survey only recruited PMRI teachers who were contactable by the PMRI local teams in each city. The results of the survey might be different if it could have involved the uncontactable teachers who might show more (or less) enthusiasm towards RME. Furthermore, the interview which supplemented the survey was only conducted with the observed teachers, due to time and resources constraints. Interviewing more teachers might give more insight into how the teachers perceive and interpret RME.

Secondly, due to the time and resources constraints the classroom observations were only conducted in Jakarta, where the researcher resided. Teachers teaching the same grade and the same topic in other cities might enact RME principles differently, from what is presented in this research. The PMRI teachers in some cities (such as Palembang or Banjarmasin) may have received more support than PMRI teachers elsewhere, such as in Jakarta. Support for PMRI is uneven in Indonesia, some PMRI local centers have more human resources in the form of PMRI experts or Dutch-educated scholars, to assist them in PMRI-related activities and development programs. In receiving more support, these teachers may show more consistency with RME ideas than the teachers observed in this study.

Thirdly, the implementation was only observed in the lower primary grades. The teachers for this grade mentioned that the students are too young to be taught in a full RME style. Similar research for teacher teaching in higher grades might also make some difference. Moreover, during the presence of the researcher in the three classrooms in Jakarta, the only topic covered was addition and subtraction of numbers up to 100 (the arithmetic topic). Similar observations for geometry or measurement topics in Indonesian schools might also make some difference.

9.3 Concluding Remarks

As found in the literature, the key determinant of borrowing a teaching practice being successful is to evaluate the compatibility between the imported practice and the local culture, beliefs and institutional conditions. When learning from another culture, it has to be realized that a well-developed program or ideology, such as RME, has evolved within and so has adapted to a particular cultural context, such as the Netherlands. This is in line with what Leung (2001, p.47) says,

> "One should always humbly learn from traditions other than one's own, but at the same time it should be realized that different practices are based on different deep-rooted cultural values and paradigms, whether explicit or implicit, that have been built up over the centuries".

Given that RME is the product of Dutch culture, it cannot be simply transplanted without taking into consideration the cultural differences between the Netherlands and Indonesia. RME was implemented in the Netherlands in line with the various aspects of their mathematics educational and cultural contexts. Consequently, RME is natural for Dutch educators and students to implement and participate in, whereas for Indonesians, the approach is foreign and interpreted through their own culture. When a teaching method is transferred to a new country it inevitably might change in the process.

For a country like Indonesia struggling to find the best practice for their education, this finding points to the need to start looking at, and reflect on, their own situation rather than simply adopting from others. Given that Indonesian culture is rooted in the Javanese tradition, which is remarkably different from other East-Asian and Western cultures, Indonesian educators should be very self-critical when learning from others and when identifying what is best for their local conditions. There is no single best approach to teaching and learning, as Clarkson and Atweh (2003, p.7) says, "it is a different thing if we uncritically view, for whatever reason, that what we practice and believe is, or indeed must be, universal or perhaps the best possible option, no matter what the cultural context". Finally, if a successful reform agenda is desired, great effort should be made by all related stakeholders in Indonesia, and the significance of culture in such an agenda deserves due attention.

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Appendix

Appendix 1A: Attitude Questionnaire (Original Version – Dutch)

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Attitude Vragenlijst over Rekenen en Rekenonderwijs (AVRR)

Nummer:

A	Datum:	……….............		
B	Geslacht:* (*omcirkel het juiste antwoord)	Vrouw	Man	
C	Type school:*	SBO	(Z)MLK	Ander s ....
D	In welk niveau/groep geeft u les?* (vergeleken met het reguliere basisonderwijs)	3	4	Ander s ....
E	Welke rekenmethode(n) gebruikt u?	....		
F	Ervaring met huidige rekenmethode:*	< 1 jaar	1 tot 2 jaar	> 2
G	Ervaring met realistische rekenmethode:*	< 1 jaar	1 tot 2 jaar	> 2
H	(Eerdere) ervaring met niet-realistische rekenmethode:*	< 1 jaar	1 tot 2 jaar	> 2
I	Is de school in het bezit van de speciaal rekenen map voor realistisch rekenen in het S(B)O groep 3 (rekenen tot 20 en getalverkenning tot 100)?*	Ja	Nee	Weet niet
J	Zo ja, gebruikt u deze map in uw klas?*	Ja, ongeveer	Nee	

Instructie

Hieronder staan stellingen over rekenen en rekenonderwijs.

Wilt u aangeven in hoeverre u het met iedere stelling eens of oneens bent.

Kies hiertoe steeds één van de vijf antwoordmogelijkheden.

Het is de bedoeling dat u uw eerste reactie geeft en niet dat u lang nadenkt over elke stelling.

Elk antwoord is goed, als het maar uw eigen mening weergeeft.

Als u een antwoord nader wilt toelichten, kunt u dit op de achterzijde van de vragenlijst doen.

Let op: omcirkelt u alstublieft maar één antwoord per stelling
en slaat u alstublieft geen stellingen over.

		oneens	beetje oneens	niet oneens, niet eens	beetje eens	eens
1.	Ik vind het belangrijk de samenhang tussen rekenen en andere vakgebieden te bespreken...	1	2	3	4	5
2.	Ik denk dat mijn leerlingen goed kunnen samenwerken in de rekenles..............................	1	2	3	4	5
3.	Ik hecht in de rekenles veel waarde aan het goede antwoord op een vraag......................	1	2	3	4	5
4.	Ik denk dat mijn leerlingen hun oplossingsmethoden goed kunnen verwoorden................	1	2	3	4	5
5.	Ik denk dat contextopgaven leerzamer zijn dan kale sommen...	1	2	3	4	5
6.	In het ideale geval nemen de leerlingen mijn oplossingsmethode over..............................	1	2	3	4	5
7.	Ik vind dat realistisch rekenen waardevol is in het speciaal basisonderwijs.......................	1	2	3	4	5
8.	Ik denk dat mijn leerlingen te veel afdwalen als ze zelf rekenopgaven mogen onderzoeken..	1	2	3	4	5
9.	Ik denk dat mijn leerlingen zelf met oplossingsstrategieën komen.....................................	1	2	3	4	5
10.	Ik wil mijn leerlingen stimuleren meerdere oplossingsmethoden uit te proberen................	1	2	3	4	5
11.	Ik wil mijn leerlingen stimuleren rekenopgaven vrij te onderzoeken...................................	1	2	3	4	5
12.	Ik vind de relatie tussen de alledaagse werkelijkheid en de rekenles belangrijk................	1	2	3	4	5
13.	Ik denk dat het activeren van voorkennis van mijn leerlingen belangrijk is.........................	1	2	3	4	5
14.	Ik denk dat mijn leerlingen in staat zijn flexibel te rekenen...	1	2	3	4	5
15.	In het ideale geval leren mijn leerlingen tijdens de rekenles het meeste van mij................	1	2	3	4	5
16.	Ik denk dat mijn leerlingen weinig leren van het aan elkaar uitleggen van antwoorden......	1	2	3	4	5
17.	Ik denk dat niveauverschillen tussen mijn leerlingen benut kunnen worden bij realistisch rekenen ...	1	2	3	4	5
18.	Ik denk dat het verwoorden van eigen oplossingen voor mijn leerlingen te moeilijk is........	1	2	3	4	5
19.	Ik denk dat de getallen die we dagelijks tegenkomen bruikbaar zijn in de rekenles...........	1	2	3	4	5
20.	Ik denk dat mijn leerlingen elkaar afleiden tijdens een interactieve les..............................	1	2	3	4	5
21.	Ik sta achter de uitgangspunten van realistisch rekenen..	1	2	3	4	5
22.	Ik denk dat samenwerken in de rekenles te veel gevraagd is voor mijn leerlingen............	1	2	3	4	5
23.	Ik denk dat mijn leerlingen niet met eigen oplossingsmethoden komen.............................	1	2	3	4	5
24.	Ik wil mijn leerlingen stimuleren mijn oplossingsmethoden over te nemen.........................	1	2	3	4	5
25.	Ik vind dat de inhoud van mijn rekenles moet worden afgestemd op de interesses van mijn leerlingen	1	2	3	4	5
26.	Ik denk dat realistisch rekenen alleen voor het regulier (basis)onderwijs geschikt is.........	1	2	3	4	5
27.	Ik denk dat reflectie op oplossingsmethoden tot niveauverhoging leidt bij mijn leerlingen..	1	2	3	4	5
28.	Ik wil mijn leerlingen stimuleren eigen oplossingsmethoden te gebruiken..........................	1	2	3	4	5
29.	Ik wil mijn leerlingen stimuleren antwoordgericht te werken...	1	2	3	4	5
30.	Ik wil dat mijn leerlingen zoveel mogelijk opgaven op formeel niveau oplossen................	1	2	3	4	5
31.	Ik denk dat contextopgaven voor mijn leerlingen verwarrend zijn......................................	1	2	3	4	5
32.	Ik denk dat mijn leerlingen het beste algemeen geldende rekenregels kunnen leren.........	1	2	3	4	5

33.	Ik denk dat mijn leerlingen in de rekenles het meest leren van goede antwoorden............	1	2	3	4	5
34.	Ik denk dat het zelf ontdekken van rekenkundige relaties te moeilijk is voor mijn leerlingen..	1	2	3	4	5
35.	Ik denk dat ik realistisch rekenen tot een succes kan maken in mijn klas..........................	1	2	3	4	5
36.	Ik wil in mijn klas de relaties tussen verschillende oplossingsmethoden bespreken...........	1	2	3	4	5
37.	Ik wil mijn leerlingen strikt bij het onderwerp van de rekenles houden...............................	1	2	3	4	5
38.	Ik denk dat mijn leerlingen inzicht in rekenkundige procedures kunnen ontwikkelen..........	1	2	3	4	5
39.	Ik denk dat mijn leerlingen in staat zijn inhoudelijk op elkaar te reageren..........................	1	2	3	4	5
40.	Ik denk dat mijn leerlingen rekenopgaven op meerdere manieren kunnen oplossen..........	1	2	3	4	5
41.	Ik vind het belangrijk om mijn leerlingen zelf rekenopgaven te laten onderzoeken.............	1	2	3	4	5
42.	Ik wil dat mijn leerlingen hun rekenopgaven via een standaard methode oplossen............	1	2	3	4	5
43.	Ik wil begrijpen hoe mijn leerlingen aan hun antwoorden komen.......................................	1	2	3	4	5
44.	Ik zou alle uitgangspunten van realistisch rekenen in mijn lessen willen verwerken...........	1	2	3	4	5
45.	Ik vind het belangrijk dat mijn leerlingen de relaties tussen verschillende opgaven zien....	1	2	3	4	5
46.	In het ideale geval worden er tijdens mijn rekenles meerdere oplossingsmethoden besproken...	1	2	3	4	5
47.	Ik denk dat mijn leerlingen de relaties tussen opgaven pas zien als ik die duidelijk uitleg..	1	2	3	4	5
48.	Ik vind dat mijn leerlingen uitdagende rekenopgaven moeten krijgen................................	1	2	3	4	5

Bedankt voor het invullen van deze vragenlijst!

Appendix 1B: Attitude Questionnaire (Bahasa Indonesia)

Kuesioner Untuk Guru PMRI

<u>Bagian A: Data Diri.</u>

Silahkan memberi tanda '√' pada kotak yang sesuai .

Jenis kelamin: □Laki-laki □Perempuan
Usia (tahun): □25-34 □35-44 □45-54 □>55
Pendidikan : □ S1 PGSD □ S1 (Pend.) Matematika □ S1, Lainnya □S2/S3
Kelas yang diampu : □ 1 □ 2 □ 3 □ 4 □ 5 □ 6
Pengalaman mengajar (termasuk tahun ini): ………… Tahun

Pengalaman mengajar dengan PMRI: …… Tahun

Bagian B: Sikap/Pandangan Mengenai PMRI

Dalam bagian ini, terdapat 48 pernyataan yang menunjukkan pandangan Bapak/Ibu mengenai penggunaan PMRI di kelas Bapak/Ibu. Silahkan melingkari angka yang paling sesuai dengan pandangan Bapak/Ibu mengenai pernyataan-pernyataan berikut.

1-Sangat tidak setuju, 2-Tidak setuju, 3-Netral, 4-Setuju, 5-Sangat setuju.

1. Menurut saya, penting untuk membahas keterkaitan antara matematika dengan bidang studi lainnya.	1 2 3 4 5
2. Menurut saya, siswa saya dapat saling bekerja sama dalam pelajaran matematika.	1 2 3 4 5
3. Bagi saya, jawaban yang tepat dari suatu pertanyaan sangatlah penting dalam belajar matematika.	1 2 3 4 5
4. Menurut saya, siswa saya mampu menyampaikan dengan baik cara penyelesaian soal yang dikerjakan.	1 2 3 4 5
5. Menurut saya, latihan dalam bentuk soal kontekstual lebih bermakna dibandingkan soal hitungantanpa konteks.	1 2 3 4 5
6. Idealnya, siswa mencontoh metode saya dalam mengerjakan soal.	1 2 3 4 5
7. Menurut saya, Pendidikan Matematika Realistik pada tingkat sekolah dasar sangatlah bermakna.	1 2 3 4 5
8. Menurut saya, terlalu berlebihan jika siswa diperkenankan mengerjakan soal latihan hitungan secara mandiri.	1 2 3 4 5
9. Menurut saya, siswa saya mampu menemukan cara penyelesaian soal sendiri.	1 2 3 4 5
10. Saya mendorong siswa saya untuk mencoba berbagai cara penyelesaian soal.	1 2 3 4 5
11. Saya mendorong siswa saya untuk mengerjakan soal latihan hitungan dengan cara yang bebas.	1 2 3 4 5
12. Menurut saya, hubungan antara kehidupan sehari-hari dengan pelajaran matematika itu penting.	1 2 3 4 5
13. Menurut saya, sangatlah penting untuk menggali pengetahuan awal yang dimiliki siswa saya.	1 2 3 4 5
14. Menurut saya, siswa saya mampu mengerjakan soal hitungan dengan fleksibel.	1 2 3 4 5
15. Idealnya, siswa saya paling banyak belajar dari saya selama pelajaran berlangsung.	1 2 3 4 5
16. Menurut saya, siswa hanya belajar sedikit saja dari saling menjelaskan jawaban satu sama lain.	1 2 3 4 5
17. Menurut saya, perbedaan tingkat kemampuan yang ada di antara siswa dapat dimanfaatkan dalam pembelajaran Matematika Realistik.	1 2 3 4 5
18. Menurut saya, siswa saya terlalu sulit untuk menjelaskan cara penyelesaian soal yang mereka kerjakan.	1 2 3 4 5
19. Menurut saya, angka-angka yang ada dalam kehidupan sehari-hari akan berguna dalam pelajaran matematika.	1 2 3 4 5
20. Menurut saya, siswa saya saling mengalihkan perhatian (menggangu) dalam kegiatan interaktif (diskusi kelas).	1 2 3 4 5
21. Saya selalu beracuan pada prinsip dasar Matematika Realistik.	1 2 3 4 5

22. Menurut saya, terlalu berlebihan jika meminta siswa bekerja bersama-sama dalam pelajaran matematika.	1 2 3 4 5
23. Menurut saya, siswa saya tidak bisa menemukan cara penyelesaian soal sendiri.	1 2 3 4 5
24. Saya mendorong siswa saya untuk mencontoh metode saya dalam memecahkan masalah.	1 2 3 4 5
25. Menurut saya, isi dari pelajaran yang saya bawakan harus dapat disesuaikan dengan minat siswa.	1 2 3 4 5
26. Menurut saya, pelajaran Matematika Realistik hanya cocok untuk siswa di sekolah reguler (bukan untuk siswa dengan kesulitan belajar).	1 2 3 4 5
27. Menurut saya, refleksi terhadap cara penyelesaian suatu soal akan mengarah pada peningkatan kemampuan belajar siswa.	1 2 3 4 5
28. Saya mendorong siswa saya untuk menggunakan cara penyelesaiannya sendiri atas suatu soal.	1 2 3 4 5
29. Saya mendorong siswa saya agar bekerja dengan berorientasi akan jawaban.	1 2 3 4 5
30. Saya ingin agar siswa saya mengerjakan lebih banyak soal latihan pada tingkat formal.	1 2 3 4 5
31. Menurut saya, latihan dalam bentuk soal cerita itu membingungkan bagi siswa.	1 2 3 4 5
32. Menurut saya, siswa saya sebaiknya mampu mempelajari aturan hitungan standar yang umum berlaku.	1 2 3 4 5
33. Menurut saya, siswa cenderung paling banyak belajar dari jawaban yang tepat (bukan dari saat mereka memberikan jawaban yang salah)	1 2 3 4 5
34. Menurut saya, siswa saya terlalu sulit untuk menemukan sendiri relasi keterkaitan antar konsep matematika.	1 2 3 4 5
35. Menurut saya, pelajaran Matematika Realistik dapat berjalan dengan sukses di kelas saya.	1 2 3 4 5
36. Saya senang membahas keterkaitan antara berbagai cara penyelesaian soal di kelas saya.	1 2 3 4 5
37. Saya ingin agar siswa saya mengikuti suatu topik dalam pelajaran matematika dengan mutlak/seksama (tidak keluar dari pembahasan topik tersebut).	1 2 3 4 5
38. Menurut saya, siswa saya dapat meningkatkan pemahaman akan langkah-langkah pengerjaan soal-soal matematika.	1 2 3 4 5
39. Menurut saya, siswa saya mampu untuk saling memberikan tanggapan yang berkaitan dengan konteks pelajaran matematika.	1 2 3 4 5
40. Menurut saya, siswa saya dapat mengerjakan soal latihan dengan berbagai cara pemecahan masalah.	1 2 3 4 5
41. Menurut saya, penting untuk memberi siswa saya kesempatan untuk mengerjakan soal latihan sendiri.	1 2 3 4 5
42. Saya ingin agar siswa saya mengerjakan soal latihan menggunakan metode standar.	1 2 3 4 5
43. Saya ingin memahami bagaimana cara siswa saya menemukan jawaban.	1 2 3 4 5
44. Saya ingin memanfaatkan prinsip dasar Matematika Realistik dalam setiap pelajaran saya.	1 2 3 4 5
45. Menurut saya, penting jika siswa saya dapat melihat adanya keterkaitan antara berbagai macam soal latihan.	1 2 3 4 5
46. Idealnya, berbagai metode pemecahan masalah akan dibahas selama pelajaran saya berlangsung.	1 2 3 4 5
47. Menurut saya, siswa saya baru dapat melihat adanya keterkaitan antara soal-soal latihan ketika saya yang menjelaskannya.	1 2 3 4 5
48. Menurut saya, siswa saya harus mendapatkan soal-soal latihan matematika yang menantang.	1 2 3 4 5

Terimakasih banyak atas pemikiran dan waktu yang telah Bapak/Ibu berikan dalam melengkapi kuesioner ini!

Catatan: Kuesioner ini dikembangkan oleh Verbruggen, Frickel, Boswinkel dan van Hell (Hak Cipta tahun 2006) dan diterjemahkan dari versi aslinya oleh Fajar Kurniawan S.S.

Appendix 1C: Attitude Questionnaire (English Translation)

PMRI Teacher Questionnaire

Section A: Personal Information.

Please put a '√' in the appropriate box .

Gender: □Male □Female
Age (years): □25-34 □35-44 □45-54 □>55

Education : □ PrimaryTeacher Edu □ Math Edu □ Bachelor Degree (Other) □Postgraduate

Grade you are currently teaching: □Grade 1 □ Grade 2 □ Grade 3 □ Grade 4 □ Grade 5 □ Grade 6
(4) Years of teaching experience: …………

(5) Years of teaching experience with PMRI: ……

Section B: Attitude towards PMRI

In this section, there are 48 items to represent your attitudes towards PMRI. Please circle the number which best describes your agreement with each statement.

1-StronglyDisagree, 2-Disagree, 3-Neutral, 4-Agree, 5-Strongly Agree.

1.	I think it is important to discuss the connection between mathematics and other disciplines.	1	2	3	4	5
2.	I think my students can cooperate in the math lesson.	1	2	3	4	5
3.	For me, the correct answer towards a question is important in mathematics lessons.	1	2	3	4	5
4.	I think my students can articulate their solution methods.	1	2	3	4	5
5.	I think contextual problems are more instructive than bare number problems.	1	2	3	4	5
6.	Ideally, my students will start using my solution method.	1	2	3	4	5
7.	I think Realistic Mathematics Education is valuable in the primary education.	1	2	3	4	5
8.	I think students will stray off too much if they have to investigate the mathematics problems by themselves.	1	2	3	4	5
9.	I think my students can come up with their own solution strategies.	1	2	3	4	5
10.	I encourage my students to try out different methods of solution.	1	2	3	4	5
11.	I encourage my students to solve math problems freely.	1	2	3	4	5
12.	I think the relationship between the real-life world and the mathematics lesson is important.	1	2	3	4	5
13.	I believe that activating students' prior knowledge is important.	1	2	3	4	5
14.	I think my students can do flexible calculation.	1	2	3	4	5
15.	Ideally, my students learn the most from me during mathematics lesson.	1	2	3	4	5
16.	I think my students do not learn much by explaining their answers to each other.	1	2	3	4	5
17.	I think that the differences in ability level can be put to use in Realistic Mathematics Education.	1	2	3	4	5
18.	I think it is difficult for my students to articulate their own solutions.	1	2	3	4	5
19.	I think the numbers we encounter in daily life are useful in math.	1	2	3	4	5
20.	I think my students distract each other during an interactive lesson.	1	2	3	4	5
21.	I hold up the principles of Realistic Mathematics Education.	1	2	3	4	5
22.	I think cooperation in the mathematics lesson is too much to ask for my students.	1	2	3	4	5
23.	I think my students will not come up with their own solution methods.	1	2	3	4	5
24.	I encourage my students to copy my solution methods.	1	2	3	4	5
25.	I think the content of my math class should be tailored to the interests of my students.	1	2	3	4	5
26.	I think the Realistic Mathematics Education is only appropriate for students in regular school.	1	2	3	4	5

27.	I think that reflection on their solution method will raise students' level of understanding.	1	2	3	4	5
28.	I encourage my students to use their own solution methods.	1	2	3	4	5
29.	I encourage my students to work response-oriented.	1	2	3	4	5
30.	I want my students to solve problems as much as possible at formal level.	1	2	3	4	5
31.	I think contextual problems will confuse my students.	1	2	3	4	5
32.	I think it is best if students learn calculation rules that are generally valid.	1	2	3	4	5
33.	I think my students learn most from good answers in mathematics lesson.	1	2	3	4	5
34.	I think discovering mathematical relationships by themselves is difficult for my students.	1	2	3	4	5
35.	I think I can make Realistic Mathematics approach into a success in my classroom.	1	2	3	4	5
36.	I want to discuss the relationships between different solution methods in my class.	1	2	3	4	5
37.	I want my students to keep strictly to the topic of the mathematics.	1	2	3	4	5
38.	I think my students can develop an understanding of mathematical procedures.	1	2	3	4	5
39.	I think my students are able to react to each other in a substantive way.	1	2	3	4	5
40.	I think my students can solve math problems in multiple ways.	1	2	3	4	5
41.	I think it's important for my students to explore math problems by themselves.	1	2	3	4	5
42.	I want my students to solve math problems using a standard method	1	2	3	4	5
43.	I want to understand how my students get their answers.	1	2	3	4	5
44.	I want to incorporate all principles of realistic mathematics in my lessons.	1	2	3	4	5
45.	I think it's important that my students see the relationships among different problems.	1	2	3	4	5
46.	Ideally, different solution methods are discussed in my class.	1	2	3	4	5
47.	I think my students can only see the relationships between problems if I explain them clearly.	1	2	3	4	5
48.	I think that my students should be given challenging mathematical problems.	1	2	3	4	5

Thank you for completing this questionnaire.

Notes: The questionnaire was developed by Verbruggen, Frickel, Boswinkel and van Hell (copyright 2006). The Indonesian version was translated by Fajar Kurniawan S.S, and the English version was translated by the help from drs. Frans van Galen.

Appendix 2A: Teacher Interview Schedule (English)

1. Has the way you teach, particularly teaching math, changed over the course of your career?
2. How do you see the Realistic approach in teaching and learning mathematics? What do you learn the most from RME?
3. What are the challenges to utilize the approach in your classroom?
4. What do you think about the use of realistic problem in your teaching?
5. In the questionnaire you agree that contextual problems are meaningful. Please comments on this
6. You barely start the lessons by giving contextual or realistic problems. Please comments on this
7. What kind of tasks or problems do you usually give to your students?
8. What do you think about the use of model and scheme for your students in learning math? What are the purposes?
9. How did you come up with the ideas of using ‘straws’? For instance inspired from textbooks, from a development programs, etc. What was the purpose of using ‘straws’?
10. Why do you give the same tasks to all students, regardless their ability? How do you accommodate students with different ability level?
11. In your opinion, how should teacher guide students to learn mathematics? What is the purpose of providing worked sample with detailed steps in your lesson?
12. What was the purpose of introducing the standard method in your lesson?
13. How do you see an interactive lesson in your class?
14. In the questionnaire you agree that interactions between students are important. Please comments on this
15. In your lesson you did not give much opportunity for your students to explain each other answer. Please comments on this
16. In your opinion, what is the purpose of thematic approach in teaching and learning mathematics?
17. Why did you structure the lesson in working unit rather than incorporating different mathematical topics in one lesson?

Appendix 2B: Teacher Interview Schedule (Bahasa Indonesia)

1. Apakah cara Bapak/Ibu mengajar, khususnya matematika, mengalami perubahan selama karir mengajar Ibu?
2. Bagaimana Bapak/Ibu melihat pendekatan PMRI dalam pembelajaran matematika di kelas? Menurut Bapak/Ibu aspek apa yang paling penting dalam PMRI?
3. Apa saja tantangan yang Bapak/Ibu hadapi dalam melaksanakan pendekatan PMRI ini?
4. Apa pendapat Bapak/Ibu mengenai soal-soal kontekstual?
5. Dari jawaban Bapak/Ibu dalam pengisian kuesioner yang lalu, Bapak/Ibu menyatakan bahwa soal kontekstual itu bermakna. Bisa dijelaskan lebih lanjut mengenai hal ini?
6. Bapak/Ibu terlihat jarang sekali menggunakan masalah atau soal kontekstual untuk memulai materi di kelas. Bisa dijelaskan mengenai hal ini?
7. Soal seperti apa yang biasanya Bapak/Ibu berikan kepada siswa?
8. Apa pendapat Bapak/Ibu mengenai penggunaan model, media, alat peraga, skema, atau cara cepat dalam belajar matematika? Apa tujuannya?
9. Bagaimana Bapak/Ibu bisa mendapat ide menggunakan sedotan? Misalnya dari Buku Teks atau pelatihan dan sebagainya. Apa tujuan penggunaan sedotan?
10. Mengapa semua siswa diberikan soal yang persis sama dalam latihan? Di kelas Bapak/Ibu, bagaimana mengakomodasi siswa dengan kemampuan berbeda-beda?
11. Menurut Bapak/Ibu bimbingan seperti apa yang seharusnya diberikan di dalam pelajaran matematika? Apa tujuan memberikan contoh soal dengan langkah pengerjaan yang runtut?
12. Apa tujuan pengenalan rumus atau metode susun panjang atau susun pendek misalnya?
13. Bagaimana Bapak/Ibu melihat pembelajaran yang interaktif? Apa tujuan interaksi di kelas?
14. Di dalam kuesioner, Bapak/Ibu setuju bahwa interaksi antara siswa itu penting. Bisa dijelaskan mengenai hal ini?

15. Selama kelas berlangsung jarang sekali Bapak/Ibu memberi kesempatan bagi siswa untuk saling menjelaskan jawaban. Bagaimana menurut Bapak/Ibu mengenai hal ini?
16. Menurut Bapak/Ibu apa tujuan penggunan pembelajaran tematik dalam belajar matematika?
17. Selama observasi, Bapak/Ibu mengajar hanya satu topik misalnya penjumlahan atau pengurangan saja. Bagaimana menurut Bapak/Ibu tentang hal ini?

Appendix 3A: Interview with Curriculum Developer (English)

1. What was the consideration behind the curriculum reform in 2006?
2. What were the factors that influence the formulations of the aim/objectives of mathematics education as presented in the curriculum document? (e.g. political, economic, social, cultural factors)
3. What were the backgrounds behind the drawing up of the mathematics curriculum in KTSP? (You may also explain the background as presented in the “policy analysis of math curriculum” document)
4. What are the main references used by the curriculum team in developing the current mathematics curriculum?
5. Is there any specific educational model or theory adopted in the curriculum? Is RME one of them?
6. Who were involved in the curriculum development other than the team from curriculum center? Are there any PMRI specialist involved?
7. In the “policy analysis of math curriculum” document, it was mentioned that RME was one of the references in the drawing up of the 2006 math curriculum, how much actually it has influence the overall curriculum?
8. The curriculum is organized in content-based but at the same time is using thematic approach. Could you please comment on this? Why content-based approach was chosen?
9. What is the purpose of the centralized decision on the contents to be covered?
10. What kinds of supports are provided for teachers to enact the curriculum?
11. What is the weakness of the current curriculum version?
12. What are your suggestions to improve the current curriculum?

Appendix 3B: Interview with Curriculum Developer (Bahasa Indonesia)

1. Apakah ada pertimbangan khusus sehingga kurikulum matematika ikut mengalami perubahan pada tahun 2006?
2. Faktor-faktor apa saja yang mempengaruhi perumusan tujuan pendidikan matematika seperti tercantum pada kurikulum (misalnya faktor politik, ekonomi, sosial, budaya)?
3. Apa sebenarnya latar belakang dibalik peyusunan kurikulum matematika seperti tertuang dalam KTSP pada saat itu? (Bapak juga dapat merujuk pada dokumen Kajian Kebijakan Kurikulum Matematika)
4. Apa referensi utama dalam pengembangan kurikulum KTSP?
5. Apakah ada teori atau model pembelajaran matematika tertentu yang diadopsi oleh kurikulum saat ini? Apakah RME salah satunya?
6. Siapa saja pihak yang terlibat dalam pengembangan kurikulum matematika selain dari Puskur sendiri? Sepengetahuan Bapak, apakah ada Ahli atau Professor pendidikan matematika yang juga merupakan bagian dari tim PMRI?
7. Saya merujuk pada dokumen kajian kebijakan kurikulum matematika, disana disebutkan RME adalah salah satu pendekatan yang dijadikan referensi dalam pengembangan kurikulum. Sejauh apa sebenarnya pengaruhnya terhadap pembentukan kurikulum saat itu? Apa ada tim PMRI yang terlibat dalam konsultasi pembentukan kurikulum tersebut?
8. Mengenai organisasi kurikulum matematika di KTSP, pada mata pelajaran matematika itu belajarnya walaupun tematik tapi fokus terhadap konten matematika. Apa Bapak bisa menjelaskan mengapa pendekatan ini yang dipilih?
9. Konten yang dicakup oleh kurikulum juga sudah ditentukan oleh pemerintah pusat. Mengapa pemerintah memutuskan untuk mengambil pendekatan ini, apa tujuannya?
10. Hal apa saja yang dilakukan Puskur untuk mendukung (memberi support kepada) guru dalam mengimplementasikan kurikulum matematika saat ini?
11. Apakah kekurangan yang dimiliki kurikulum matematika yang digunakan saat ini?
12. Apa saran Bapak untuk memperbaiki kurikulum matematika saat ini?

Appendix 4A: Interview Schedule with Textbook Writer (English)

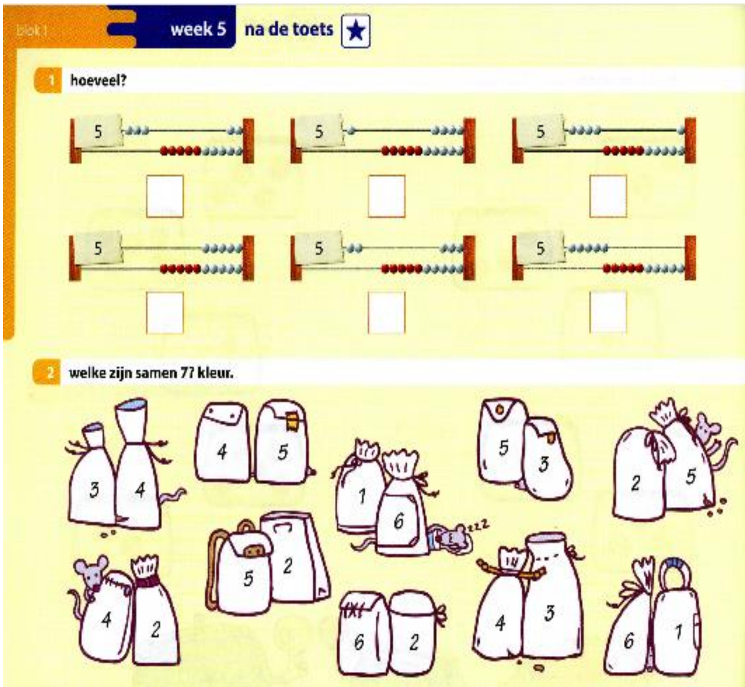
1. How long have you been working as a textbook writer?
2. What is your educational background? Do you have teaching experience?
3. What is the purpose of the textbook? Is it a teacher or student book?
4. What are the references you used in writing the textbook?
5. How did you structure the textbook?
6. The curriculum suggests thematic approach for teaching and learning in lower grades. How do you interpret this?
7. In your textbook, you give suggestion to use standard formulas and rules, what is the purpose?
8. In your textbook, there are only a few contextual problems and numerous bare number problems, what is the purpose?
9. Why did you put the contextual problems at the end of the chapters?
10. In your textbook, you only provide one set of questions in the exercise. How do you accommodate students with different abilities?
11. Have you heard about PMRI?
12. Are you interested in learning about Realistic Mathematics Education in the future?
13. Have you read the PMRI textbook?
14. What do you think about the current textbook? What is your suggestion?

Appendix 4B: Interview Schedule with Textbook Writer (Bahasa Indonesia)

1. Berapa lama Bapak telah menjadi penulis buku pelajaran Matematika?
2. Mengenai latar belakang pendidikan, Bapak dulu menempuh pendidikan di mana? Apakah bapak memiliki pengalaman mengajar?
3. Buku pelajaran matematika yang Bapak tulis sebetulnya ditujukan sebagai Buku Guru atau Buku Siswa?
4. Referensi apa yang bapak gunakan dalam menulis buku teks matematika?
5. Bagaimana Bapak menyusun struktur buku pelajaran matematika yang Bapak tulis?
6. Kurikulum menyarankan penggunaan pendekatan tematik dalam pembelajaran di kelas bawah. Bagaimana Bapak menginterpretasikannya?
7. Di dalam buku yang Bapak tulis, Bapak menyarakan penggunaan rumus-rumus (misalnya metode susun ke bawah dalam penjumlahan dan pengurangan di kelas satu), apa tujuannya?
8. Di dalam buku yang Bapak tulis, hanya ada sedikit soal kontekstual dan banyak sekali soal latihan tanpa konteks (khususnya pada bagian materi penjumlahan dan pengurangan). Apa tujuannya?
9. Mengapa soal-soal kontekstual disimpan di bagian belakang suatu Bab?
10. Di dalam buku yang Bapak tulis, Bapak menyarankan satu set latihan soal saja untuk semua siswa. Bagaimana Bapak mengakomodasi siswa yang memiliki kemampuan berbeda-beda?
11. Apakah Bapak pernah mendengar tentang PMRI? Sejauh apa Bapak mengenal PMRI?
12. Apakah Bapak berminat untuk mengenal PMRI di masa yang akan datang?
13. Apakah Bapak pernah membaca buku PMRI?
14. Apa saran Bapak untuk buku teks yang ada saat ini?

Appendix 5: Example of Task Differentiation in *De Wereld in Getallen*

Basic Task (One-Stared Task)



Advanced Task (Three-Starred Task)