Chapter 15
Research Rationalities and the Construction of the Deficient Multilingual Mathematics Learner

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15.1 Introduction

Improving access to education and quality of achievement, especially in mathematics, has been a focus of educational research as well as of reform initiatives globally over the last two decades (e.g., EFA[1]). While advances have been made on access to education, the status of achievement, especially in mathematics, remains a major concern the world over. This is evident from the wide range of cross-national comparative initiatives and studies, such as SAQMEC,[2] TIMMS,[3] and PISA, that are undertaken to look at student achievement in mathematics. These studies regularly produce

[1] Education for All (EFA) is an international commitment first launched in Jomtien, Thailand in 1990 to bring the benefits of education to "every citizen in every society." EFA has six major goals (for details see http://www.unesco.org/education/efa/ed_for_all/).

[2] The Southern and Eastern Africa Consortium for Monitoring Educational Quality (SACMEQ) is an international nonprofit developmental organization of 15 Ministries of Education in Southern and Eastern Africa. A key purpose is to apply scientific methods to monitor and evaluate the conditions of schooling and the quality of education, with technical assistance from UNESCO International Institute for Educational Planning (http://www.sacmeq.org/about.htm).

[3] The Trends in International Mathematics and Science Study (TIMSS) is an international assessment of the mathematics and science knowledge of fourth-grade and eighth-grade students around the world. TIMSS was developed by the International Association for the Evaluation of Educational

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evidence that a proportion of the children studied are underachieving. Who are the underachieving students and what can be done to remediate their situation have been topics of research in general education as well as in mathematics education.

Nevertheless, the increasing importance given to large-scale international, comparative studies, due to their growth and expansion since the 1960s, has contributed to a conflation between the measurement of students' achievement and children's experience of mathematics education. The effects of this quantification have made it possible to think that there is in fact a correspondence between achievement and the mathematical experience of children, in particular for those who underachieve. A large proportion of the underachieving children are precisely those who belong to nondominant social groups in their respective countries (e.g., OECD, 2006). For example, "those whose parents have a low level of education, who have low socioeconomic status, or come from an immigrant background, as well as boys, have a higher risk of low performance at age 15. Some 19 % of people at this age in OECD countries lack basic literacy skills, making it more likely that they will drop out of school with no qualifications" (OECD, 2012, p. 72). The quantification has also made it possible to see that it is the same students who fail year after year. Such observations are also connected to the construction of an image of cognitive, linguistic, and cultural deficit in those who fail, relative to those who succeed.

These studies do not necessarily provide a framework to understand and further investigate why and how current practices of teaching and learning in classrooms, especially when these processes are taking place in multilingual and multicultural classrooms, produce the systematic failure of many students belonging to nondominant cultural groups. This is a significant issue because of three main reasons. First, increasingly during the twentieth and twenty-first centuries there is a growing idea that success in school mathematics is a prerequisite for personal and national success. Second, in the globalized world today more children are multilingual than monolingual, and many classrooms bring together a diversity of children. When educational practices effect systematic exclusion and failure for some, the result is that a large proportion of children are in fact being excluded from participation in education. Third, language use in the classroom is not simply a matter of communication and cognition; language use as a political, social, and cultural tool is also important in understanding the teaching and learning processes.

For these three reasons and many others, mathematics education researchers have studied mathematics education practices in multilingual and multicultural classrooms. They have focused on the teaching and learning of mathematics of those students whose languages and culture (and also ethnicity) diverge from the language and cultural norms of dominant cultural groups in society. It is the hope of multilingual research in mathematics education to understand this situation in-depth, in order to devise better and more suitable educational practices that can help the children thus implicated in succeeding in school mathematics and in life. Research rationalities, with their theories and methodologies become an important

Achievement to allow participating nations to compare students' educational achievement across borders (http://timss.bc.edu/)

element in studying how researchers and their research can live up to the challenge of making changes possible.

In this chapter, we focus on the research rationalities made visible in published research papers studying mathematics teaching and learning in multilingual classrooms. We interrogate these rationalities from a point of view that highlights the implication of research practices in the construction of the very same problems it intends to study and address. We depart from the assumption that educational research, and within it, mathematics education research, is not a neutral player in this game. Increasingly during the twentieth century, educational research is regarded as the expert knowledge that is supposed to help people planning and building a better world. As research produces knowledge that is used in dealing with perceived problems of reality, it has a double effect of power. On the one hand, its concepts and ways of proceeding reify categories of exclusion by documenting their same existence. That is, research itself is implicated in the creation of the differentiation of multilingual/multicultural children. It constructs the idea of the "deficient multilingual child" inasmuch as it attempts to change the teaching and learning practices implicated in rendering it in the first place. The good intentions of researchers result in the construction of the very same category they want to dissolve. On the other hand, research provides the knowledge-based technologies for engineering how multilingual/multicultural children need to be helped, in order to diminish the gap between them and the dominant cultural groups. That is, the research sets up mechanisms of subjectification for children to become assimilated into the values, worldviews, and forms of being and knowing of those whose culture is the norm. The intention of helping diversity also has the effect of undermining its very existence.

This double effect of power in research allows us to evidence that the theoretical and methodological choices of research, educational or otherwise, are not value neutral. Rather they are built on assumptions about what is valued as knowledge and, therefore, what are valorized as approaches and frameworks for the generation of knowledge. No political examination of research and research methodology can leave this point unattended, particularly when the teaching and learning of mathematics for children of nondominant linguistic and cultural groups is highly political.

15.2 Examining Research Rationalities

Many researchers dealing with the study of mathematics education in multilingual settings declare that their research is political since it attends to the connection between language and power in the society. Gutstein (2007) summarizes this stance in these words:

> Thus, in a sense, politicizing the discussion around language usage is not a choice mathematics educators have the luxury of making—circumstances dictate that for us. Language is political in many ways […] Language is about power, about who has the authority to designate the language of instruction and the "official" languages. It is also about students' identity and being, and to denigrate one's language is to disparage her culture, personhood, community, ancestors, and ways of making sense of the world. (pp. 244–245)

Even if not explicitly declared, many researchers adhere to the view expressed above. If the research on mathematics education in multilingual settings is political, the issue of the ways in which research addresses power becomes important to study. There could be different ways in which mathematics education research deals with the political. One way is by the implicit or explicit adoption of different views on power and how research argues that power enters mathematics education teaching and learning practices (Valero, 2008). Another possibility is to carry out "research on research": that is, analyzing how research itself is implicated in effecting power and constituting the political (Pais & Valero, 2012). Following this critical trend allows us to understand the ways in which scientific knowledge is more than the socially privileged form of getting reliable information about the state of affairs in the world, such as the percentage of bi-/multicultural and bi-/multilingual children who underperform in mathematics in the world. The knowledge of research is central in, on the one hand, maintaining a narrative of rational and planned progress in society on the grounds of objective and solid knowledge for devising better, evidence-based solutions and, on the other hand, constituting "social epistemologies" (Popkewitz & Brennan, 1997). Following Popkewitz and Brennan (1997), epistemology provides a context in which to consider the rules and standards by which knowledge about the world and self is formed:

> social epistemology locates the objects constituted by the knowledge of schooling as historical practices through which power relations can be understood. Statements and words are not signs or signifiers that refer to and fix things, but social practices that generate action and participation. (p. 293)

Mathematics education research, in general, is a field of study inserted in a particular logic that is defined by a growing tendency to limit the object of study to phenomena of learning and teaching. Biesta (2005) calls this tendency the "learnification" of educational research. One of the consequences of this tendency for mathematics education is the disavowal of the Political as a constitutive element in mathematics education practices and research (Pais & Valero, 2011). Researching research in the field of mathematics education in multilingual settings is an attempt to take a critical look at the research rationalities that contribute to the generation of ways of thinking about the people and practices of mathematics education in those settings, their problems, and the ways of addressing them. In the case of research in mathematics education in multilingual settings, critical research into existing research would invite us to examine the ways in which such research is not only embedded in "patterns of power relations" (Popkewitz & Brennan, 1997), but also and more importantly how it is implicated in generating the categories, distinctions, and forms of thinking about the practices of schooling and the people involved in multilingual mathematics classrooms. Critical research also constitutes an invitation to denaturalize the idea that the purpose of research is to directly propose better ways of dealing with teaching and learning practices and people in multilingual contexts. In other words, this type of critical research allows us to evidence how research contributes to the creation of ways of reasoning about the "problems" and the "solutions" to the very same problems it identifies and constructs.

In deploying our analytical strategy, we bring forward the term *research rationalities*. This is both a theoretical and methodological tool that allows us to link the intention of evidencing social epistemologies and the concrete examination of research texts in the area that we are studying. Research as a practice of knowledge is organized around the identification of problems that require knowledge to be addressed, as well as conceptualizations of the problems. The ways of proceeding of the researcher both in terms of the logic of the activity (the methodology) and the concrete forms of examination of evidence (the information collection methods) guide the process of constituting new knowledge. The research rationalities are the resulting forms of constructing problems, thinking about them, and devising solutions. As methodological tools, research rationalities allow us to examine the enunciations that repeatedly appear in papers and that constitute statements of truth about the problems that research addresses, the conceptualizations about the practices involved, and the solutions proposed.

More concretely, in examining research rationalities, we will deploy a Foucault-inspired discourse analysis (Arribas-Ayllon & Walkerdine, 2008) where we trace the enunciations that, repetitively in series of documents and texts, constitute forms of thinking about the objects that the researcher is focusing on. Such type of analysis, more than a procedure, is an analytical strategy that brings together the conceptual and theoretical tools along with a reading of the corpus under examination. We have looked mainly at mathematics education research on teaching and learning emanating over the last two decades, with a focus on multilingualism in mathematics education and related issues as noted above. We examined key journals published in English in the field of mathematics education and mathematics teacher education, and books and chapters in international collections. We have traced research rationality by identifying in the texts: (a) how the learner is portrayed; (b) how mathematics education (teaching and learning) is portrayed; and (c) the notion of language as formulated in the texts.

In the following, we address the elements outlined above in our analysis of the research rationalities in multilingual research in mathematics education. We distinguish between two types of studies: large-scale quantitative studies and small-scale qualitative studies. Even though we see these types to be connected in a broader discourse, they deploy different strategies to approach the study of multilingual settings, and as a consequence present slightly different, though not unrelated, rationalities.

15.3 The Logic of Achievement Gaps Research

Large quantitative studies have produced systematic evidence for certain truths about education: there exists differential achievement of students in school subjects. Since the mid-1960s, the time of the launch of the Coleman Report in the United States, discussion of the quality of education has focused on the relationship between the inputs in students' characteristics and students' outputs as measured

through achievement in the dominant school subjects: that is, an education production function or an input–output model has been the dominant way of thinking about what makes a difference for school achievement. Quality of education and the differential gaining of different types of students had, from the 1920s until that time, primarily been measured in terms of the quality of resources put into schools (Coleman, 1972). One of these resources is "what students bring with them". The variable of students' socioeconomic status entered the scene of social and educational research in the early 1920s and since then has become a central parameter in these types of measurements (Sims, 1930). Coleman and his collaborators shifted the concept of equality of opportunity in education to rely on the connection between school inputs and outputs, by adding the connection between inputs to the outputs measured in terms of performance on standardized tests (Gamoran & Long, 2006). As part of a political trend at that time of starting to base policy on social research results, the Coleman Report opened a whole new way of understanding the effects of education in creating differentiation. The application of new statistical techniques and of social surveys, connected with the growth of both national and international large-scale banks of statistical measurements of educational effectiveness laid the ground for which facts such as "the achievement gap" emerged during the twentieth century. Realizing how social science and educational research (also mathematics education research) have constructed concepts and facts (Hacking, 1999) is important in understanding how certain research rationalities about the educational outputs of (multilingual) children in (multilingual) settings operate. Studies addressing how students, who operate with more than one language in situations where mathematics teaching and learning is carried out in one or more languages, are embedded in the logic and rationality of these types of studies.

Discussions of achievement gaps in mathematics in other countries have gained importance in a social context that not only increasingly emphasizes the connection between individual achievement in mathematics—but also science and mother tongue—with personal economic prosperity, and national economic welfare and competitiveness in global economies. Studies emphasizing the importance of examining the gaps (Lubienski, 2003), as well as those criticizing the effects of gap-gazing (Gutiérrez & Dixon-Román, 2011; Parker, 2000; Parks, 2009) have emerged in mathematics education. While probably in many national contexts, the issue of groups of students not performing as well as expected were taken as a matter of "the natural distribution of mathematical ability", the growing discourse of mathematics for all as part of political and economic agendas of progress and prosperity have posed clearly the achievement gap as a challenge for both equity and also productivity (Valero, 2013). Our point in mentioning these connections is that the growing association between mathematical achievement and economic and social prosperity is also part of the discursive network within which the quantitative research rationality for the study of mathematical achievement of multilingual students operates.

The discussion of the achievement gap in mathematics has been known to mathematics education research mainly through the publication of research in English-speaking countries, particularly the United States. Such research explains the statistical fact that white students as a group, independently of in-group variation,

seem to systematically outperform students from other racial groups, particularly African Americans, Latino(a)s and Native Americans. In the context of the United States, the category "racial and ethnic groups" intersects with the category of "learners of English" or "second language learners". The latter may apply clearly to Asians and Latino(a)s, while it may not be clearly the case for African Americans or Native Americans. At the same time, the category of "language learner" quite often intersects in important ways with the variable of "poverty" (Brown, Cady, & Lubinski, 2011). When reviewing existing research that addresses the learning of mathematics of "English language learners", a majority of papers were found to concentrate on the experiences of Latino(a)s. Such prominence could be related to the fact that, despite being the largest and fastest growing immigrant group, it is also the group of immigrant students or language learners who show the lowest school performance, but also have become the least educated immigrant population with only 11 % of adults completing a bachelor degree (Schneider, Martinez, & Owens, 2006).

The case of the United States is interesting in illustrating this type of research. Parks (2009) presents a critical reading of how research has contributed to producing an achievement gap and how such a production has a power/knowledge effect on the forms of thinking and writing about the students who do not perform well. She concludes that:

> For minority students, the act of taking a standardized test may work to invoke stereotypes about performance even without an explicit reminder because phenomena like the achievement gap are so widely accepted as real. Thus, the achievement gap works in two ways […] First, its acceptance as a real phenomenon impacts student performance on tests, and second, the tests then go on to produce evidence, in the form of test scores, that the phenomenon is, in fact, real. That's power/knowledge. (p. 16)

In our analysis we chose to concentrate on one document that builds on the dominant framing of many large-scale quantitative studies on achievement gaps: the OECD's report on the failure of immigrants on the grounds of the PISA 2003 dataset, "Where immigrant students succeed: A comparative review of performance and engagement in PISA 2003" (OECD, 2006). Discursively, PISA epitomizes many of the statements that nowadays constitute a kind of "regime" about what counts as mathematics education (Kanes, Morgan, & Tsatsaroni, 2014). It claims to be a wide international comparison including a diverse set of countries, and it has been quite influential for policy. Besides, it claims to assess skills for real-world application that are acquired by 15-year-olds, an age which marks the end of compulsory education in most countries (Neidorf, Binkley, Gattis, & Nohara, 2006). In accordance with our analytical strategy, our analysis of this report will illustrate three aspects of the research rationality: how research portrays students, mathematics education, and language. Whenever necessary, we complement our analysis with other documents to highlight recurrence in enunciations and statements concerning these three points.

A very first important element in these studies is the representation of a person into an identifiable record to which an aggregate of variables are attached. Each single individual student participating in the PISA test can be identified and singled out if one wants to. There are background information variables on the record, which are associated with another aggregated measurement, which is the overall

achievement in the test and its subparts. Once dependent and independent variables are defined, individual students with histories and bodies disappear, metamorphosing into measurements. A dominant measurement that is highlighted in the discourse is *achievement*, in our case achievement in mathematics. But the achievement is not only taken to be the particular performance of one person in a particular test; the measurements of achievement are taken to be "students' learning" and "students' ability to apply their knowledge and experience to real-life situations" (OECD, 2006, p. 25).

Achievement—in other words, learning—is the dependent variable connected to other associated measurements of each individual student. Place of birth generates the categories of *immigrant*, who can be *first generation* student, or *second generation* student, and *native*. Connected to this there is the distinction between *home language* which may differ from the national language and *language of assessment*, and other official languages. Here, the focus is on the proportion of immigrants who speak a different home language from the language of assessment: few natives speak a different home language than the language of assessment.

Other variables called background information are students' *parents*' *educational level* and their *social*, *economic*, *and cultural status*. School characteristics are also possible explanatory independent variables. Furthermore, students' dispositions to education measured in their *motivation*, *beliefs about themselves*, and *perception of school* are also considered. Different analyses are used to produce results about how these variables relate and which seem to have explanatory force concerning achievement.

The results are clear: "immigrant students are motivated learners and have positive attitudes towards school. Despite these strong learning dispositions immigrant students often perform at significantly lower levels than their native peers in key school subjects, such as mathematics" (OECD, 2006, p. 3). Those who perform at the lowest point are first generation immigrants who do not speak the language of assessment at home (pp. 45–46) they tend to "perform at substantially lower levels than their low-performing native peers" (p. 41). In general, boys perform better than girls in mathematics for all the types of students (p. 49). The general performance difference among types of students is such that "in the majority of countries at least one in four immigrant students do not demonstrate basic mathematics skills as defined in the PISA 2003 assessment" (p. 3).

There is a "relationship between the relative mathematics performance of immigrant students and their relative educational and socio-economic background" (p. 9). The differences in parents' socioeconomic background can largely account for the lower performance in relation to the native peers (p. 58). In general, parents of immigrant students tend to have a lower socioeconomic situation or level of education than parents of native students (p. 58). However, parents' socioeconomic background and level of education are not the only contributing factors to explain the differences. School factors such as the tracking system or the number of immigrant students in school also have an influence. There are more differences in students' performance in relation to between-school variance than within-school variance (pp. 78–80).

The logic of this type of research is a comparative logic that is built on measurements of difference in relation to a neutrally determined norm. In particular, achievement results establish a comparison between each individual and a specified standard that is stratified in terms of proficiency levels. Low achievement on a particular standard also indicates low proficiency in relation to that standard. The measurement in itself builds on the hierarchical organization of attributes. A low measurement inevitably positions an individual in a deficit zone. This type of deficit positioning is at the very heart of the types of comparative reasoning of this kind of research. Since the measurements are taken at one point in time, they represent static pictures of positions of students, their learning and the causes for their low performance. Nevertheless, the discursive effect is a reification of a particular picture into population generalizations that are attributed to groups of population. Even though the report insists on the differences between the cases analyzed in the study, the general formulation of results still overshadows the small, and probably significant, differences.

The portrait of language (and multilingualism) is also limited to two dimensions: the correspondence between home and assessment language; and the level of proficiency in language, again measured by the average score on language proficiency tests. The category "immigrant" conflates with the category "language learner". The diversity of languages that may make part of an actual teaching and learning situation in mathematics is only slightly acknowledged; however, the analysis requires a clear-cut category that positions immigrants against the dominant cultural norm represented by the national language and the language of assessment. The result of this type of logic is a differentiation between home languages, being ranked in a secondary, less powerful position, against the desired cultural norm for communication, thinking, and learning: the national language and the corresponding language of instruction and assessment.

Drawing from the above, it becomes clearer that methodological choices in large-scale, quantitative research, educational or otherwise, are not value neutral. They are built on assumptions about what is valued as knowledge and cultural norms, and therefore produce valorized approaches and frameworks for ranking students, learning and language.

While the dominant methodological frameworks such as those undertaken in large-scale comparisons of mathematics achievement are governed by concerns of equity and excellence, they have created their own methodological imperatives and reified particular "truths" about "language learners" and their school results. Excellence, for instance, has translated into the need to have measurable standards to ascertain mathematical proficiency, to ensure that no student is left behind in the economic competition for social and economic welfare. Achievement is measured in relation to standards, and the proficiency levels of different ethnic, linguistic, or socioeconomic groups, or of different countries internationally, are seen in terms of achievement gaps. Individual students, schools, language minority groups, other disadvantaged groups, states, and countries are seen as ahead or falling behind in terms of scores on testing instruments that are developed and analyzed from a perspective of "reducing the gaps" (Schütte & Kaiser, 2011). It is important to note that

the "gap-gazing effects", as Gutiérrez and Dixon-Román (2011) call it, embed in themselves important discursive effects that go beyond the limits of the good intentions of evidencing the problems of low achievers and tend to confine the students, their families, their languages, and their learning to a locked, unmovable position. Or as Parks (2009) phrases it, the whole discourse of achievement gaps and the research rationality it builds keeps the attention away from the effects that "definitions of mathematics, inequity, cultural or language hegemony" (p. 19) have for those on the wrong side of the gap.

Unpacking the research rationality of these studies is important because it brings us back to the complex, unpredictable and inequitable nature of social realities that confront educational research; all of them epitomized in the intersection of multilingualism, social class, gender, ethnicity, etc. The discourse of this type of research obliterates the messiness and uncertainties through the reduction of students and learning to well-defined numerical variables for statistical manipulation. From a wider social and political perspective it becomes evident that "the problem of failure in mathematics cannot be resolved within the boundaries of mathematics education alone […] it demonstrates the inconsistency of a system that on the one hand demands mathematics for all but on the other hand uses it as privileged mechanism for selection and credit" (Valero & Pais, 2012, p. 173).

15.4 The Logic of Classroom Research

Besides the large-scale studies noted above, the last three decades or so have seen the emergence of qualitative, often small-scale, studies in mathematics education situated in the context of schools and classrooms, with long-term engagement in the field as compared to the more traditional notion of data collection as a one-time event. Many of these studies have looked at issues of mathematics teaching and learning and teacher education within multilingual settings.

For example, the role of code-switching, translation, translanguaging, or the use of other linguistic devices in facilitating or hindering learning mathematics has been well documented in mathematics classrooms in post-colonial countries where the medium of instruction is often the language of the colonizers, or in classrooms with immigrant learners where the medium of instruction is the language of the host country (Barwell, 2009; Gorgorió & Planas, 2001; Halai, 2009; Moschkovich, 2007; Norén, 2008, 2011; Setati, 1998; Setati & Adler, 2000; Then & Ting, 2009). It is established in these studies that, in many countries, multilingualism in mathematics is a norm rather than an exception. In most cases use of multiple languages is perceived by many participants in educational processes (politicians, administrators, leaders, teachers, and the public in general) in mainly two ways: as a "deficit" that needs to be addressed so that learners become proficient in the use of the language of instruction; or as a "scaffold" or a "resource" to support the process of learning mathematics by drawing from multiple languages.

Dilemmas and tensions have been identified in multilingual mathematics classrooms. For example, Adler (2001) identifies three interrelated "dilemmas" that lie at the heart of teaching mathematics in multilingual classrooms (p. 15). Barwell (2009) highlights at least three 'tensions" that arise in the context of multilingual mathematics classrooms (p. 60). Prediger, Clarkson, and Bose (this volume) propose a framework for bringing together three hitherto disparate processes: "code-switching […], transitions between informal and academic (mathematical) forms of language within a given language, and transitions between different mathematical representations. Exploring the overlap between these three ideas and in particular by articulating their interconnections, new insights and implications are gained." These theoretical concepts show quite categorically the mutually constitutive relationship of language and development of mathematics knowledge.

Studies have also looked at the politics of language dynamics as they play out in classrooms illustrating the higher prestige of language of instruction as compared to the learners' home/dominant language with a consequence that official teaching and learning processes are conducted in the language of instruction while learners' language is relegated to a secondary status (Halai, 2009; Setati, 2005; Valero & Pais, 2012).

Collectively, the studies noted above have made a significant contribution in drawing attention to specific issues of multilingualism in teaching and learning mathematics. However, these in-depth qualitative mainly small-scale studies do not necessarily transcend the research rationalities of the large-scale quantitative studies. Indeed, the double effect of power is reinforced in these small-scale qualitative studies as well, because the underpinning philosophical and epistemological assumptions also take as normative the framework of language of instruction. The implication is that the multilingual learner who does not necessarily share the language of instruction as a dominant language is positioned as deficient. Moreover, languages are often seen from a structuralist paradigm as disparate bounded systems with operating distinctions on linguistic categories.

For example, in a detailed analysis of how research in mathematics education discriminates on the basis of language both within the community of research and practice, Barwell (2003) examined the pioneering work of Adler (1997, 2001) which studied in-depth a short teaching episode drawn from a larger study on teachers' knowledge of their practices in a multilingual secondary school mathematics classroom in South Africa. The teaching episode involved "Sue", a white, well-qualified, English-speaking, teacher who used a "participatory-inquiry approach" to teaching mathematics. In its conceptualization of the problem and process of research, this study has problematized the exclusive use of the language of instruction in teaching and learning and opened up spaces for use of additional languages in the classroom. It provides evidence of the issues related to "communicative competence" of learners and its implications for their learning. However, according to Barwell (2003), what remains largely uninterrogated is what constitutes mathematics and what constitutes communicative competence in mathematics from a multiplicity of perspectives. The study assumes a universal notion of mathematics built on the western/northern conceptions of mathematical thinking (e.g., explanation, reasoning, and

justification), expressed in the English language. In doing so, the learners whose mother tongue is not English are positioned inadvertently as deficient. Barwell (2003) goes on to maintain that "[t]he privileging of English linguistic practices or meanings may therefore perpetuate a prevailing attitude in Sue's classroom, with the potential for teaching and research to devalue other languages and linguistic practices" (p. 41).

Drawing on a larger research project, Setati (2005) closely examined the complex relationship between language and mathematics education through an in-depth study of a lesson situated in a primary school classroom in South Africa. The study highlighted the political dynamics of language use in the classroom and found that the language that got official recognition in the classroom was invariably the language of the powerful elite or, in the case of post-colonial contexts, the language of the colonizers. Through a close scrutiny of classroom processes, Setati documents that multiple language use is a resource that the learners draw upon in the course of learning mathematics. However, invariably in the dynamics of classrooms, learners proficient in English are positioned as advantaged as compared with the learners who are learning mathematics and English simultaneously. Because of the theoretical and methodological positioning of the paper, there is a dichotomy between the home language of the learners and the language of teaching and learning. For example, the analytic framework employs a variety of discourses including mathematical discourse, nonmathematical discourse, procedural discourse, and conceptual discourse. However, it is the home language (Setswana) that is positioned as the language of conceptual discourse and English as the language in which procedural discourse took place, thereby creating a dichotomy. An implication of such a dichotomy is that learners who were learning mathematics alongside learning English were actually engaged in a procedural discourse in learning mathematics (p. 461).

On the basis of a detailed review of studies in multilingual mathematics in Africa, Setati, Chitera, and Essien (2009, p. 75) validate that research in mathematics education in multilingual settings mainly in South Africa has created a dichotomy between learning in English and learning in the home languages, giving an impression that the use of the learners' home languages for teaching and learning must necessarily exclude or be in opposition to English. Elsewhere, Setati, Molefe, and Langa (2008) expose:

> [T]hree prevalent dichotomies in research on teaching and learning mathematics in multilingual classrooms. First, is the dichotomy between using English as LoLT (language of learning and teaching) as opposed to using the learners' home language(s) as LoLT. Second, is the dichotomy about drawing on socio-political perspectives when analysing interactions in multilingual mathematics classrooms as opposed to drawing on cognitive perspectives. The third dichotomy is about gaining access to mathematical knowledge as opposed to access to English. (p. 10)

The dichotomies highlighted above have implications for understanding the process of teaching and learning from a situated sociocultural perspective. Pakistan is a case that illustrates well the dichotomies noted above. As noted in Halai (2009), it is a linguistically diverse country with Urdu as the country's national language. Urdu is the primary language of less than 10 % of the population and English is the

medium of instruction in many private schools. Halai (2007, 2009) undertook observation of two small groups of students learning mathematics in an English-medium classroom and showed that language differences among the learners created new opportunities and challenges through the use of linguistic devices such as code-switching, code-mixing, and translation. Issues are noted for the learners when inappropriate translation of key mathematical terms does not enable the learners to appropriate the mathematical intent of the tasks:

> [T]he practices that students engaged in as they undertook mathematics showed movement between the language of instruction and their own language. This movement across languages involved a demonstrated need on the part of the learners to understand the language structures, grammar and vocabulary of the language of instruction. It also involved translation, which is a nuanced and complex process. Due to these complexities, questions arise about the role of code-switching in aiding the process of learning mathematics. (Halai, 2009, p. 48)

An implication of these dichotomies is that they privilege one perspective of the learner, mathematics education and language, and invariably it is the perspective of the dominant culture.

An issue is that imposition of a language and mathematics of one culture on learners who do not necessarily own it, positions the learner always as disadvantaged and "having to catch up". Language is not just a conduit of communication; embedded within it are the ways of thinking and values of people. For example, Schütte and Kaiser (2011) note that almost one-third of the students in German schools have a "migration background" and are provided support to *improve their linguistic abilities* in the German language. Looking closely at a selected classroom episode on teaching of LCM (Lowest Common Multiple), these authors illustrate the challenges for the learners who are expected to negotiate the implicit rules of the formal linguistic register or that of school mathematics concepts. Elsewhere, employing video observation of a lesson on complex fractions in a complementary school where Farsi and English are used regularly, Farsani (in press) focused on the experience of learning mathematics of bilingual, Farsi/English-speaking students of Persian heritage in the United Kingdom. Significantly it showed that complex fractions were simplified and solved in Farsi by drawing on the idiom "door dar door, nazdik dar nazdik" [far by far, near by near] (Farsani, in press). This idiom refers to the process of simplifying a complex fraction. It means the product of the two numbers furthest apart over the product of the two numbers closest to the main division line in the centre. Farsani notes that the use of this idiom opened up possibilities of learning for students of Persian heritage as they could associate with it. He raises the question of what counts as mathematics in different languages, and whether having access to more than one linguistic resource creates one or more perspectives in thinking and speaking mathematically.

The studies noted above document the challenges and issues for the learner in classrooms where they do not own the language. However, the studies do not question the almost omnipotent nature of school mathematics. The research rationalities thus honor the position of the current mathematical thought conveyed through the dominant language so that inadvertently other mathematics cultures are subjugated.

Barton (2009), through an extensive investigation, challenges the idea that mathematics is the same for everyone and goes on to argue that mathematical thought embedded in minority languages should be explored. This type of argument, however, is seldom taken in the studies noted above, which assume, through different means, that different pupils at the end will have to conform to what is legitimately prescribed as school mathematics by the curriculum.

From the discussion so far we infer that research in mathematics teaching, learning, and teacher education has been constituted by, and in turn, has constituted a dual meta-narrative: one of language as a well-defined and intact system, and the other of one school mathematics from a singular universal perspective. Thus the multilingual and multi-cultural learner remains invariably positioned as "deficient" against the power effects of this dual meta-narrative.

15.5 Concluding Remarks

In this chapter, we have focused on the research rationalities made visible in published research papers studying mathematics teaching and learning in multilingual classrooms. We have interrogated the discourses around the learner, the teaching and learning of mathematics, and language. Two types of studies were examined: large-scale, international comparative studies and small-scale, qualitative studies. The former constituted the logic of achievement gaps, and the latter the logic of classroom research. Both the theories and methods deployed by researchers contribute to the creation of the differentiation of multilingual/multicultural children. Research contributes to the construction of the idea of the "deficient multilingual child". It also provides the knowledge-based technologies of teaching and learning to engineer how multilingual/multicultural children need to be helped in order diminish the gap between their position and that of dominant cultural groups. Finally, in research, language is often portrayed as a static possession that learners have or do not have, and that allows classifying them in relation to the language use of the mainstream groups of society presented as proficient. It could be concluded that the research rationalities, as evident in the emerging body of knowledge in the field of mathematics education, have contributed to the construction of a deficient multilingual learner. This is through several unquestioned or unchallenged assumptions, implicit in meta-narratives of mathematics, mathematics teaching and learning, language and the learner him/herself. Positioned thus, educational research becomes a tool for perpetuating the values, worldviews, and ways of knowing and being of the dominant culture.

However, from a cross-disciplinary and poststructuralist perspective epistemological spaces are emerging for studying mathematics teaching and learning in multilingual and multicultural settings. For example, linguists such as Street (2003) propose literacy (and by implication language) as a "situated social practice" embedded in cultural and social contexts with concomitant power and authority relationships. Elsewhere, Makoni and Pennycook (2006) challenge the current

discourse of bi/multilingual education with associated notions such as code-switching, as reproducing the historical logic of classification on which mainstream linguistic thought was built, so that "multilingualism may therefore become pluralization of monolingualism" (p. 22). They argue strongly for a renewed view that focuses on linguistic practices and people's transitions of language for the purpose of communication.

A strong implication of this theoretical positioning is to problematize the assumption that teachers and learners bring clearly defined systems of language into classrooms, because language in practice is fluid, moves across boundaries and takes meaning in context. Taking such a poststructuralist view would provide an approach to rethink the concepts with which we as researchers gaze on mathematics classrooms with multiple languages, as well as to democratize the educational process and contribute to greater equality and opportunity.

To conclude, the discussion in this chapter suggests that understanding and improving the quality of mathematics education, especially the classroom processes of teaching and learning necessarily goes beyond the search for measureable and numerical quantitative data. A more complex and nuanced approach is recommended to study the quality of mathematics learning as part of a broader reform initiative in education and development. Research rationality cannot be conceptualized without a deeper questioning of philosophical, epistemological, and ontological assumptions that underpin the traditional norms of what constitutes mathematics and by implication mathematics education research.

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