

***Case on the Switch of Numeral Form in Mathematics Textbook in Maharashtra,
India***

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Abstract

Section 29(2)(f) of the Right of Children to Free and Compulsory Education (RTE) Act, 2009 provides that “the medium of instruction shall, as far as practicable, be in the child’s mother tongue.” Many research articles have emphasized the importance of teaching in the mother tongue but how important is teaching regional numbers in this converging global society? Maharashtra, a state in India, uses vernacular numerical system till class IV for mathematics only to completely shift to English numerals in class V while continuing the use of vernacular system for the rest of the subjects. This shift could be a major challenge for a child’s learning if not supported with expertise to ensure the shift smoothly. For the past 13 years the Annual Status of Education Report (ASER) has reported the flat learning trajectory and how children are not able to attain foundational literacy and numeracy. In such a scenario, the shift of numerals can further widen the learning gap. ASER Centre recently conducted a pilot asking children aged between 4 to 8 years to read vernacular (Marathi) numbers and English numbers from 1 to 99 – on an average children could identify 15% more English numbers than Marathi numbers. Children’s exposure to English numbers through currency, television, smartphones which are easily accessible to the lower economic strata of the population build a natural understanding of English number system outside of the academic ecosystem. Is it really necessary to make the children go through this shift is a question to ask.

Keywords: Language, Mathematics, Education, Numbers, Right to Education, Primary Education

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Introduction

Thomas Dye described public policy as ‘anything a government chooses to do or not to do’. Expanding on further, public policy refers to the decisions that the government makes for the general public. Policies are not made overnight; instead, they come through after a tiring and tedious process with multiple stages involving a lot of back and forth. India is a multilingual country and its language policy continues to be debated even after 72 years of Independence. Language is a medium to communicate and help understand the concepts of science, geography, maths, history, etc. Studies have found evidence to suggest that the mother-tongue as a medium of education leads to better academic performance. The Education policy in India has also recognised its importance and under section 29(2)(f) of the Right of Children to Free and Compulsory Education (RTE) Act, 2009 provides that “the medium of instruction shall, as far as practicable, be in the child’s mother tongue”.

Maharashtra, a state in India, uses Devanagari numerical system till class IV for mathematics only to completely shift to English numerals from class V onwards. The policy goal is to preserve regional numbers and ease children’s understanding of numbers at the primary level by using regional number names and by introducing English numbers later it aims to prepare children for the converging global society. However, Annual Status of Education Report (ASER) reports have pointed out that children are not attaining grade level competency. As per their latest report, ASER 2018 about 24% children in Std IV could not identify 2-digit numbers. This paper hopes to point out that the language for Mathematics is an **inconsistent policy tool** for the policy goal of multilingualism and is creating an additional constraint in learning Mathematics for children. Taking the case of Maharashtra specifically, the paper follows a mixed approach to analyse the loopholes in the policy using qualitative and quantitative analysis.

Background

India is one of the countries that have the highest number of languages in the world . The Linguistic Diversity Index ranks India at 14 as per SIL International, 2017. As per the Census of India 2011- Linguistic survey of India, 121 languages are considered as mother tongues¹ and of these, 22 languages are included in the Eighth Schedule to the Constitution of India and are called Scheduled languages. Of the total population of India, 96.71 percent have one of the Scheduled languages as their mother tongue, the remaining 3.29 percent is accounted for by other languages. 43.6 percent of the population in India has Hindi as their native language, followed by Bengali – 8.03 percent and Marathi – 6.86 percent. As the Census data suggest, India is a multilingual country and there is no national language. As per the Part XVII of Constitution of India, Chapter 1-Articles 343 and 344, has defined two official languages (the language used by the government) of India - Hindi, written in Devanagari script, and English. It also states that “The form of numerals to be used for the official purposes of the Union shall be the international form of Indian numerals.” However, the President can authorize the use of the Devanagari form of

¹ As per Census, ‘Mother tongue is the language spoken in childhood by the person’s mother to the person.’

numerals² in addition to the international form of Indian numerals³ for any official purposes for a certain period. As per Article 345 of the Indian Constitution, “the Legislature of a State may by law adopt any one or more of the languages in use in the State or Hindi as the language or languages to be used for all or any of the official purposes of that State”.

As per Howlett, political systems define state policy capacity and the process followed in making and implementing policies. India has a federal political system, wherein there exist two autonomous levels of government - central and state level government. They are not bound together in a subordinate relation and enjoy discretion as guaranteed by the Constitution. Education policy is made by the central government and state government at the national and state level respectively. The National Council of Educational Research and Training (NCERT), thus, makes curriculum-related policy at the national level. Similarly, there are state government bodies that make policies on state curriculum practices. There have been various researches on the importance of education in the child’s mother tongue medium. The Indian Constitution has also recognised the importance of mother tongue as a medium of instruction, Article 350A states that “it shall be the endeavour of every State and of every local authority within the State to provide adequate facilities for instruction in the mother-tongue at the primary stage of education to children belonging to linguistic minority groups; and the President may issue such directions to any State as he considers necessary or proper for securing the provision of such facilities.’ All children of the age of six to fourteen years old are entitled to free and compulsory education under the RTE Act 2009. It also provides under Article 29 (2)(f) that the "medium of instruction shall, as far as applicable, be in child's mother tongue". According to , the number of languages used as medium of instruction has reduced significantly. While most private schools has English as their medium of instruction, almost in all government schools children are taught in their regional language.

To facilitate teaching in mother tongue and to have a common language taught across India for ease of communication the “Three-Language Formula” was formulated in 1968 by Ministry of Education, Government of India. The formula provided that in Hindi speaking states, children will be taught Hindi, English and one other Indian language. The policy proposed that children in Hindi speaking states preferably learn one south Indian language to promote multilingualism. For non-Hindi speaking states, the formula mentioned that children be taught Hindi, English and their regional language. The three-language policy has received criticism for imposing teaching of Hindi to all states in India. The Chief Minister of Tamil Nadu, 1967-1969, opposed to teach Hindi in Tamil Nadu, "What serves to link us with the outside world is certainly capable of rendering the same service inside India as well". The three-language formula has been accepted in most of the states of India but the pattern of instruction is not identical and varies in-between states, depending on their language policy.

² Devanagari form of numerals are from the Devanagari script used in Hindi speaking states of India and Maharashtra

³ International form of Indian numerals here means normal English number.

Regional numeral forms and Education Policy

In India, not all languages have its own form of numerals. Out of the 22 scheduled languages as defined in the eighth schedule of the Constitution, only 10 have its own form of numerals – Gujarati, Punjabi, Bengali, Odia, Telegu, Kannada, Tamil, Malayalam and Devanagari (used both in Hindi and Marathi). However, the usage of these regional form of numerals has declined. Numerals of south Indian languages like Kannada, Malayalam, Tamil, and Telegu, have become archaic and are rarely used. Devanagari, Bengali, Odia, Gujarati and Assamese numerals are taught in school to students. In the state of West Bengal, Bengali numbers are used in their Mathematics book throughout the schooling years. While in Maharashtra, Gujarat, Odisha and Assam children are taught Mathematics using the regional form of numerals till primary (up to Std IV) and then it is switched to English numerals Std V onwards. As mentioned in the introduction, the policy aims to achieve multilingualism agenda. Considering these numerals are used extensively across the state, and that mother tongue also includes regional number names, the policy aims to preserve traditional regional numerals and ease children's learning of Mathematics. By introducing English numerals at a later stage the policy targets to prepare children for the globalising society. In many other places around the world this kind of a switch happens as well like in Myanmar. This paper discusses how this policy can act as an hurdle in learning of children in the context of India.

Quality of Education in India

Education policy are supposed to make the learning easier for children but not all policy tool gets implemented as planned. Failure to consider the context can lead to major gaps in policy goal and policy results. The Right of Children to Free and Compulsory Education Act, 2009 has ensured near-universal enrolment in schools. However, low attendance of children and poor quality of education in schools has created a major learning gap. The World Development report 2018 correctly points out the challenge that India is facing, 'Schooling is not the same as learning'. As per the Annual status of education report (ASER), India has almost reached universal enrolment with out of school children standing at 2.8% as per ASER 2018 report. However, the learning trajectory remains flat. India ranked 103 on 130 in the World Economic Forum - Global Human Capital Report, 2017. In the Education Index⁴ by the United Nations, India ranked at 135 out of 187 countries in 2013.

There has been a number of learning assessments done internationally as well as national and state level. India had participated in the **Program for International Student Assessment (PISA)**⁵ in 2009 and ranked 72 out of the 74 countries and since then the country decided to not participate in it anymore. Since 2005, **Annual Status of Education Report (ASER)**⁶ has reported that children have been not acquiring the

⁴ The Education Index is Calculated using mean years of schooling and expected years of schooling

⁵ PISA is a test for secondary school students that assesses subjects – science, mathematics, and reading. The test is done across major countries and aims to create comparable evidence on the learning outcomes of children around the world. It aggregates the performance of children and ranks countries accordingly. PISA test started in 2000 and is done every three years.

⁶ ASER Centre, the independent research wing of the Pratham Education Foundation (PEF) has been conducting the Annual Status of Education Report (ASER) survey for the last 13 years, the only nationally

foundational reading and arithmetic ability and that the learning trajectories has remained flat. The latest report, ASER 2018 was conducted in 596 rural districts in India and around 5.40 lac children were tested on foundational literacy and numeracy. Of all children enrolled in Std V, 50.3% of children could read at least an Std II level text and only 27.8% children in Std V could divide (3-digit by 1-digit division). In the **National Achievement Survey (NAS)**⁷ conducted in 2017 by NCERT, the average score of class V children in Mathematics stood at 53% and for class VIII children it was 42%.

It is often the teachers who are blamed for the poor learning outcomes because they are unskilled, but that's the symptom and not the cause. The teacher candidates also come from the same low-quality schools with poor content knowledge and the pre-service education programs do not appear to be helping. There exists no selection criteria for the pre-service education programs and anyone can apply to become a teacher. The teaching profession is also considered as the lender of the last resort for most of the unemployed people in India. The poor quality of teachers graduating from these programs is evident with the low pass rates in teacher eligibility tests. Even after clearing necessary exams the content knowledge seems to be lacking. In a study of Bihar teachers, average subject knowledge of teachers was found to be weak, with the mean score in language at 45% and math at 51% (Sinha S, Banerji R and Wadhwa W 2016). Classroom practices such as reading aloud, writing on board, and no engagement with children are all associated with poor teaching. (P Kothari, R Rohatgi, D Agarwal, N Shukla and A Dwive 2016). In addition to the poor quality of teachers an 'over ambitious curriculum' and the usual practice of 'teaching to the top of the class', is further contributing to the current learning crisis.

Several assessments have reported that children are not able to cope up with the ambitious syllabus and with the poor quality of teachers, there is no mechanism within the school system to effectively address the needs of children who have fallen behind. Given the poor education levels, the mission of multilingualism seem a far-fetched goal. As mentioned earlier, in Maharashtra, Gujarat, Odisha, and Assam – children are taught Mathematics using regional numbers and it is switched to English numerals class V onwards. As per ASER 2018, 34.5% of children in grade III could not identify 2-digit numbers. Given that children are struggling to identify regional numbers, switching numbers from regional numbers to English numbers might add to the learning gap. The multilingual education is supposed to be a tool to improve education outcomes but how effective is it in improving academic performance is what is being analysed in the rest of the paper.

Case of Maharashtra: The switch of numeral form in Mathematics textbook

Maharashtra is one of the states who has the regional numerals switch in their Mathematics textbook. In their grade V Mathematics textbook, the first chapter

representative household survey on enrolment and basic learning levels in India. ASER conducts foundational numeracy and literacy tests of children aged 5-16 years old across all rural districts of India.

⁷ The National Council for Educational Research and Training (NCERT) has been conducting the National Achievement survey periodically since 2001. NAS is designed as a school-based survey of students enrolled in Std III, V, and VIII in government and government-aided schools. It is a grade-level assessment based on class-wise, subject-wise learning outcomes developed by NCERT. The main subjects covered in this survey are Mathematics, Language, Sciences and Social Sciences.

orients children with the English numeral form before starting with the math concepts for that grade. As per the ASER data for Maharashtra⁸, 4.5% of Std IV children could not identify double-digit numbers in 2010 and after RTE the number has increased to 15.8% in 2018 (Fig 1). In the grade level assessment done under the NAS survey, grade III children could solve only 65% of the problems correctly grade V students could solve only 52% of the questions.

Considering 4 years of education in regional numerals form did not help them in identifying numbers, one chapter to cover an all new numeral form doesn't seem to be the correct approach to acquaint children with a new form of numeral. The new regional form and names are nowhere similar and can be hard to adapt for children, leading to further confusion and chaos in a child's mind. Additionally, given the poor quality of teachers in India, they are not equipped on how to make that switch for children to understand it easily.

The policy tool seem to create two problem – one, they do not help achieve their own agenda of multilingualism due to the poor learning outcomes as depicted in the survey data and second, it is further messing with the child's understanding of Mathematics.

Analysis of the Policy Tool

While preparing for ASER 2019, which is focussed on early childhood education, ASER Centre piloted number recognition with children aged 4 to 8 years old in Maharashtra in both English and Devanagari numerals. The survey found out that children could recognize more English numerals than Devanagari numerals. The findings question the complexity of the numeral forms and children's exposure to the numerals. Exposure to language helps learning that language easier. As mentioned, the central government doesn't use Devanagari numbers in their formal documents and so does many state governments. But in Maharashtra, the regional numbers are used widely across the state. All notices and announcements by the government bodies have Devanagari numbers. The bus numbers at the bus stop, train numbers in boards, billboards, newspapers, the train and bus tickets all have Devanagari numbers. Even when numerals switch in Mathematics textbook, all other books continue to use regional numerals. It is important to note that while most of the signboards in Maharashtra have regional numerals but it is often accompanied by English numerals. The different commodity that people buy in their daily life has the price written in English numerals. According to ASER 2018, 90.2% of households had a mobile phone, which also gives children exposure to English numerals again. All the games that children play in mobile or video games, board games have numbers written in English numerals. So considering both numerals seem to work in the state, what is the best language to teach Mathematics and is the switch necessary to happen through Mathematics?

Role of Numeral forms and names in Mathematics

Numbers acts as a base to understanding the Math concepts, it helps to relate the quantity on which various Math concepts are based on. While there is no generally

⁸ ASER uses the language taught to children in their primary school. In Maharashtra, Devanagari numbers tool is administered to children.

accepted definition of Mathematics, Aristotle defined it as “science of quantity”(Franklin J, 2009). Foundations of Mathematics start from pre-school where children are taught basic intuitive pre numeracy concepts. The Mathematics syllabus for primary classes (Std I-V) as prescribed by NCERT includes concepts like shapes, spatial understanding, numbers sequence and operations – additions, subtraction, multiplication and division, concepts of money, measurements, weights, time and initial data handling using bar graphs. A lot of this covers number based operations and children start to related number as quantity and identifies quantities with the numeral forms taught. In the upper primary class (Std VI-VIII) the mathematical concepts taught gets a little abstract with Algebra, ratios, symmetry, and introduction to probabilities. Considering a lot is covered at the very initial age it is important to focus on what can make the learning faster and more intuitive.

What is the best language for Mathematics?

Given that children are exposed to both numeral forms and they are able to identify more English number than regional number, it is also important to understand which number names makes it easier for children to understand the quantity that numbers try to convey. While English number till 19 the place value comes first when “nineteen”, but post 20 all numbers have names like twenty-four where the place value comes later which help children understand the position of each digit in a number and making it clear that the number system is based on units of 10. When doing multi-digit addition and subtraction, children working with English number can understand that two-digit numbers are made up of tens and ones, making it easier to understand the concept of addition. While Devanagari number names have a different form of number names where the place value comes and then followed by the tens. For example, a number like 87 is called as ‘satyanshi’ in Marathi meaning seven-eighty. While mother tongue does play a role in learning these number names easily but it is important to also ensure children understand the concept behind numbers as smoothly as possible.

Considering Teachers play the most important role in implementing Education policies, there is a need that their views are taken into account when drafting changes in the policy. A short online survey was shared across Maharashtra to get views of the Grade V Mathematics teachers from government schools on what they think is the best language for Mathematics. A total of 63 teachers responded using the online link. 52% of the reported that they were not trained on how to help children make the language switch, 34% of teachers believe that this switch makes it difficult for children to understand Mathematics, 50% reported that Devanagari numbers are easier for children than English numbers, while 77% of teachers said that knowing both English and regional numbers is important, 42% believe that it is sufficient to teach Devanagari numbers as part of the Marathi language subject and is not necessary to be merged with Mathematics.

Recent Developments in the policy tool

The government state curriculum department has recently introduced a new reading style of numbers being cognizant of the gap. The new instruction directs teachers to break down the pronunciation of numbers as written to help children easily understand the number system. There exists a lot of confusion currently as no clear

guidelines has been shared as the new instruction has recently been introduced. Mangala Naraliker, Mathematics committee chairman, Maharashtra State Bureau of Textbook Production and Curriculum Research, said, "We aim to teach children in the five-six-year old age group in a simpler way. Considering students who are the first literate generation in their family, or those students who do not have anyone literate in their home, these changes have been made to enable their learning." She also agreed that "Though their primary language is Marathi, they find English numbers easier to read and write. Our teachers have found this over the years. So, to make it simple, we want students to read these numbers as they write," she said. "A majority of the students get confused learning these numbers. For example, 87 - which is read as 'satyanshi' in Marathi, can now be read as 'ainshi' (80), plus 'saat' (7)," Naraliker added. "Importantly, we have an inclusive policy; which means the older version of reading numbers is also in place in textbooks," Naraliker says, adding, "Students can choose any, as both styles of reading numbers are correct. We are not changing anything in the Marathi language, only the style of reading the Marathi numbers we are upgrading. This is only from 20 to 100, and not above 100. This is also not a compulsion," she added (Hindustan Times 2019). The new policy seems to be a good step to ease children's learning of numbers however, it lacks clarity which will lead to many other confusion in policy implementation.

Conclusion

John Campbell mentioned that a number of distinct idea sets go to into policy making: program ideas, symbolic ideas, policy paradigms and public sentiments. In the policy on usage of regional numbers in Mathematics textbook, symbolic ideas and public sentiments might have been considered but the policy contents fails to take into account the capability of the actors. As pointed in the paper both numbers are equally used in Maharashtra, while across the world English numbers are most commonly used. It is important to separate the language from Mathematics and choose the language which makes learning Mathematics easiest for the children. Familiarity with numbers, number names, teacher's capacity are few of the things that should be considered before deciding on the language for Mathematics. The subject has no link with different numeral forms and names and it is just a mode to ease the learning of many other important concepts and hence there is a need to separate the language from Mathematics. Multilingualism can be second priority and be introduced in the later stage but it is important for children to understand the Mathematics concepts well. In the effort to meet multilingualism one should not forget that it should not be at the cost of learning Mathematics. Considering that this is followed in many other states as well, it is important to consider this policy at the central level.

There is a need to filter the reality through the policy paradigm approach and analyse the policy content again. For instrument choices to be effective it must be closely related to policy goals. As Howlett mentioned, coherent goals with inconsistent tool leads to ineffective policy. Policy design is a task that involves more than policy formulation but also implementation if it has to be effective. It needs to look at the available resources and their capacity. The current policy tool has high constraints and is further affecting other policy goals – education.

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