

## Analysing our textbooks Mathematically

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Analysis of Rational Number chapters in NCERT textbook — Grades 5th to 10th

Title of the chapter	Objectives of the lesson	Mathematical topics covered	Prior mathematical knowledge assumed	Choice of examples	Any noticed gaps in mathematical content	Noticing from any other perspectives:
Group 1: Grade 5 Halves and Quarters	<ul style="list-style-type: none"> <li>• introducing fractions,</li> <li>• equal and unequal parts</li> </ul>	<ul style="list-style-type: none"> <li>• Comparing the fractions,</li> <li>• the difference between larger and smaller number — unequal parts</li> </ul>	<ul style="list-style-type: none"> <li>• Assumed that students know part and the whole</li> <li>• There is assumption that students know that whole is always greater than part</li> <li>• Understanding of area is assumed</li> </ul>	<ul style="list-style-type: none"> <li>• With the help of examples fractions are introduced</li> <li>• different types equal parts can be shown at the time of introduction</li> <li>• Question about making equal requires understanding of area, which is assumed as it is</li> <li>• shapes using triangles are asked to draw, but better would be to give them cut out outs.</li> <li>• Similarly for making four equal parts there needs to be equal area understanding needed</li> <li>• Equality can be talked through changing the unit of measurement. Measuring the same area using different units, is that possible?</li> <li>• Like making 20 equal parts and then choosing the unit of 5 cubes to make 4 equal parts (teachers presented it with drawings on the board)</li> </ul>		Not enough real life contexts

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Group 2: Grade 6 Fractions	<ul style="list-style-type: none"> <li>• Introduction to fractions</li> <li>• comparison of fractions</li> <li>• operations of fractions</li> </ul>	<ul style="list-style-type: none"> <li>• Types of fractions;</li> <li>• operations of fraction — + and subtraction</li> </ul>	<ul style="list-style-type: none"> <li>• There is assumption that students are familiar with fractions notation and representation</li> <li>• Students understand equal parts is assumed</li> </ul>	<ul style="list-style-type: none"> <li>• The beginning example in the chapter is — Two students are sharing food — 5 puris, and they have to share one puri between two, each getting an half.</li> <li>• They begin with equal halves — but they could have started with a counter example — where students are exposed to unequal parts;</li> <li>• Real life examples — contexts — half century, half litre milk, etc., are missing.</li> <li>• The share meaning of fraction — which is a day to day concept is not discussed.</li> <li>• Share explains the process, but the chapter focuses on end of distribution</li> <li>• There is very less context — from real life.</li> <li>• There is a game for half — they could have added more examples in the game.</li> <li>• Counter examples are overall missing — they would strengthen the concept understanding.</li> </ul>	<ul style="list-style-type: none"> <li>• Proper and improper fractions — are treated distinctly — where as the example used in the introduction of fractions at the beginning of the chapter — 5 puris between two students was of improper fractions.</li> <li>• The order therefore goes like this — improper fractions then proper fractions and then again improper fractions</li> <li>• Other techniques such as paper folding — with concrete experience could have been useful at many places. The focus is only on drawing parts.</li> </ul>	<ul style="list-style-type: none"> <li>• Very few figures of students are used.</li> <li>• Figures could bring social context, only one context in the entire chapter — a boy and a girl sharing their lunch.</li> <li>• We talk about NCF constructivism, but this chapter does not use that framework much</li> </ul>

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Group 3: Grade 7 Fractions and Decimals				<ul style="list-style-type: none"> <li>• Lowest form and equivalent fractions needs to be addressed in grade 6. They seem to be just assumed — lowest form can not be understood without understanding equivalence of fractions,</li> <li>• The choice of examples needs to consider students common errors — rather they have given examples where students can easily get correct answers. For example compare 15:40 with 15.56, what they should be asking is 15.56 with 15.456. This will help teacher catch student understanding.</li> <li>• All examples are very easy and do not create any problem (conflict?)</li> <li>• While introducing decimals — the need for introducing decimal is not clarified. Why should one use decimals — why not only fractions needs to be discussed.</li> </ul>		<ul style="list-style-type: none"> <li>• The discussion of where can we ask question about fractions is important — can we ask fraction of a human being?</li> <li>• The representations used in the book are monotonous and need to use multiple contexts.</li> </ul>

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Group 4: Grade 8 Rational Numbers	<ul style="list-style-type: none"> <li>Introduction and properties of rational</li> </ul>	<ul style="list-style-type: none"> <li>Operations are covered, properties</li> </ul>	<ul style="list-style-type: none"> <li>Students knowledge of natural numbers is assumed</li> <li>fractions, whole numbers and integers is also assumed</li> <li>and knowledge of simple equations — <math>5x+2 = -3</math> is assumed.</li> <li>The equation given above is used to introduce rational number. This understanding is used to reinforce what are rational numbers</li> </ul>	<ul style="list-style-type: none"> <li>There are no pictorial context in the chapter;</li> <li>the questions that are solved could have been illustrated with some representations;</li> <li>Like can we show <math>3/2 - 2/5</math> using some representations?</li> <li>The textbook uses different size of number line — and different size of the one whole on number line when they want to divide it in different number of parts.</li> <li>For example- when one one whole that is from 0 to 1 was divided among 8 equal parts the size of the whole is bigger than the whole used for dividing among three equal parts. (see page 16 of the book)</li> <li>This will reinforce students' thinking that <math>1/8</math> is bigger than <math>1/6</math> or the whole need not be same.</li> </ul>		

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Group 5: Grade 9 Numbers Systems	<ul style="list-style-type: none"> <li>We understand numbers and extend them as rational and irrational</li> <li>we take them to decimal expansion;</li> </ul>	<ul style="list-style-type: none"> <li>With focus on rational numbers and distinguish them with irrationals</li> </ul>	<ul style="list-style-type: none"> <li>Assumed knowledge of natural numbers - whole numbers, decimals, rationals and irrationals</li> </ul>	<ul style="list-style-type: none"> <li>The examples are without explanation.</li> <li>For example when they ask find five rational numbers between 1 and 2 — they do not discuss about how one finds the rational between two whole numbers.</li> <li>Examples are very straight forward later and needs to more exploring examples</li> </ul>		Gender — there is not much human figures — less of context
Group 6: Grade 10 Real numbers	<ul style="list-style-type: none"> <li>Further understanding of rationals and irrationals</li> <li>Deductive proofs using algebra</li> </ul>	<ul style="list-style-type: none"> <li>Euclid's division lemma,</li> <li>hcf and lcm,</li> <li>fundamental theorem of arithmetic,</li> <li>rational and irrational understanding — and distinguishing them</li> </ul>	<ul style="list-style-type: none"> <li>Assumed knowledge of Fractions and decimals</li> </ul>	<ul style="list-style-type: none"> <li>Direct calculation examples and some context problems.</li> <li>This chapter includes proving that <math>\sqrt{2}</math> is irrational,</li> <li>In the earlier grade <math>\sqrt{2}</math> is introduced as irrational and then how can we ask students to prove it in this grade.</li> </ul>		<ul style="list-style-type: none"> <li>Common gender is used</li> <li>equal names of both gender are used;</li> <li>Representation of middle class or there is no social class mentioned in the contexts.</li> </ul>



