# **TEC_Maths: T**extbook **E**valuation **C**hecklist for Mathematics

TEC_Maths is a checklist for quality evaluation of Mathematics textbook and the support materials that may come with it like teacher manuals and/or digital support like simulations/animations/videos/mathematical games. A textbook can contain the following, apart from content explanation - examples, chapter summary, *formative assessment* questions that students can solve in-class, *experiments* that they can try out, *summative assessment* questions, answers to *summative assessment*, notes to the teacher. TEC_Maths can be used by school principals, head of the departments and teachers to select a textbook, from the vast array that is available, such that it would support effective teaching of mathematics for their students.

TEC_Maths has 22 questions along 3 dimensions of evaluation - content quality (5 questions), pedagogical alignment (14 questions) and technology integration (3 questions).

How to use TEC_Maths:

1. Select some representative chapters from the textbook. Representative chapters can be those chapters that deal with topics that students are known to find difficult to grasp (for example, Fractions for grade 2 or Decimal numbers for grade 5).
2. Go through the representative chapters and all the support materials related to those chapters. Record your overall score for each question in TEC_Maths by judging across all the representative chapters and simply ticking against the 3-point scale – Missing, Partially satisfied and Adequate. Tick 'Adequate' if you find the textbook and support materials have addressed all the relevant points pertaining to the question. Tick 'Partially satisfied' if only a subset of relevant points have been addressed. Tick 'Missing' if none of the relevant points have been addressed.
3. Use the additional 'Remarks' column to give recommendations to improve quality of the textbook and/or support materials. In this column, you may make notes of the following nature about the textbook and support materials: i) If you have given partial ratings, write those missing requirements which would need to be included or, ii) Write what you liked about the textbook and support materials, citing examples.
4. Click on the hyperlinked terms in this document to get their detailed explanation from the 'Glossary' section.

| **Content Quality (C)** | **0 (Missing)** | **1 (Partially satisfied)** | **2 (Adequate)** | **Remarks** |
|---|---|---|---|---|
| **Score**<br>**Questions** | | | | |
| **C1. Is the content *accurate*?**<br><br>*To score this question:*<br>*Tick 'Adequate' if all of the following points are satisfied by the textbook and support materials: use of a) precise and accurate mathematical content, b) accurate mathematical terminology and c) correct concrete or abstract representations (e.g., pictures, symbols, expressions, equations, and graphics).*<br>*Tick 'Partially satisfied' if any of the above points are not satisfied* | | | | |
| **C2. Are grade-appropriate *mathematical knowledge and skills*, as outlined by the Board, addressed?**<br><br>*To score this question:*<br>*Tick 'Adequate' if the textbook and support materials address all the following points: ability to 'think and reason mathematically, to pursue assumptions to their logical conclusion and to handle abstraction, the ability and the attitude to formulate and solve problems'.*<br>*Tick 'Partially satisfied' if only some of the abilities have been addressed.* | | | | |
| **C3. Is the content situated in an appropriate *context* to illustrate the mathematical concept?**<br><br>*To score this question:*<br>*Tick 'Adequate' if relevant and sufficient context is presented to explain the content.*<br>*Tick 'Partially satisfied' if context presented is relevant but not sufficient to explain the content.*<br>*Tick 'Missing' if either no context is presented or context presented is irrelevant.* | | | | |

| **Content Quality (C)** | **0 (Missing)** | **1 (Partially satisfied)** | **2 (Adequate)** | **Remarks** |
|---|---|---|---|---|
| **C4. Are the *formative* and summative assessment questions *correct, clear and unambiguous*?**<br><br>*To score this question:*<br>*Tick 'Adequate' if the following points are satisfied by assessment questions: a) correct and b) clear and unambiguous.*<br>*Tick 'Partially satisfied' if the assessment questions satisfy a subset of the above points.* | | | | |
| **C5. Is the spelling and grammar correct, and the *formatting consistent*, in various parts of the textbook and/or support materials?**<br><br>*To score this question:*<br>*Tick 'Adequate' if all the following points are satisfied: a) spelling and grammar correct, b) formatting consistent.*<br>*Tick 'Partially satisfied' if any one of the points is not satisfied.* | | | | |

| **Pedagogical alignment (P)** | **0 (Missing)** | **1 (Partially satisfied)** | **2 (Adequate)** | **Remarks** |
|---|---|---|---|---|
| **Score**<br>**Questions** | | | | |
| **P1. Are all *necessary* learning objectives *stated explicitly* for each chapter?**<br><br>*To score this question:*<br>*Tick 'Adequate' only if all the following points are satisfied:*<br>*a) All necessary learning objectives are stated explicitly.*<br>*b) The learning objectives are written correctly.*<br>*c) The learning objectives can be easily found in expected places like at the beginning of the textbook chapter or in the teacher manual or digital support.* | | | | |
| **P2. Is the content in a chapter organized into sections that alternate with *formative assessments* and *experiments*?**<br><br>*To score this question:*<br>*Tick 'Adequate' only if textbook and digital support is sectioned in the following way: (a) The chapter is divided into small content sections.*<br>*(b) The content sections alternate with formative assessment and experiments. There should NOT be continuous content sections with formative assessments and experiments coming only at the end.*<br>*(c)Content sections, formative assessment questions and experiments should appear as logically and physically separate units.*<br>*Tick 'Partially satisfied' if any one of the above points is not satisfied.* | | | | |

| Pedagogical alignment (P) | 0 (Missing) | 1 (Partially satisfied) | 2 (Adequate) | Remarks |
|---|---|---|---|---|
| **P3. Are common student misconceptions addressed?**<br><br>*To score this question:*<br>*Tick 'Adequate' if the textbook and support materials address all major misconceptions.*<br>*Tick 'Partially satisfied' if only a subset of the major misconceptions are addressed.* | | | | |
| **P4. Are guidance provided to students to conduct *experiments* through which they can experience the mathematical phenomenon as directly as possible?**<br><br>*To score this question:*<br>*Tick 'Adequate' if the textbook or digital support outline the materials required and procedure of experiment while the observation and inference is left to the students to unravel.*<br>*Tick 'Partially satisfied' if the experiment is described in terms of materials required, procedure, observation and inferences.* | | | | |
| **P5. Are opportunities provided to students to *connect multiple concepts within or across subjects*, instead of studying in isolation?**<br><br>*To score this question:*<br>*Tick 'Adequate' only if both the following points are satisfied:*<br>*a)Connection between different subjects (for e.g. science and mathematics or social science and mathematics) are conveyed to students*<br>*b) Opportunities are provided for students to apply multiple concepts of mathematics to arrive at the correct answer.*<br>*Tick 'Partially satisfied' if any of the above points is not satisfied.* | | | | |

| Pedagogical alignment (P) | 0 (Missing) | 1 (Partially satisfied) | 2 (Adequate) | Remarks |
|---|---|---|---|---|
| **P6. Are the *formative* and *summative* assessments *aligned* with the learning objectives?**<br><br>*To score this question:*<br>*Tick 'Adequate' if there are one or more assessment questions at the same cognitive level as the stated learning objectives.*<br>*Tick 'Partially satisfied' if some of the stated objectives do not have any assessment question at the corresponding level.* | | | | |
| **P7. Are some *formative* *and* *summative* assessment questions included, that require students to demonstrate higher-order mathematical thinking skills (*HOTS*)?**<br><br>*To score this question:*<br>*Tick 'Adequate' only if the assessment questions in the textbook and support materials include all the HOTS important for the chapter.*<br>*Tick 'Partially satisfied' if some of the important HOTS have been missed* | | | | |
| **P8. Are opportunities provided for group activity among students?**<br><br>*To score this question:*<br>*Tick 'Adequate' if the group activity satisfies the following points: (a) build on each other's expertise to together come up with a correct solution, (b) students discuss & debate the solution within their group.*<br>*Tick 'Partially satisfied' if the group activity does not satisfy any one of the above points.* | | | | |

| Pedagogical alignment (P) | 0 (Missing) | 1 (Partially satisfied) | 2 (Adequate) | Remarks |
|---|---|---|---|---|
| **P9. Do the answers given for the *summative* assessment questions, provide corrective and explanatory feedback?**<br><br>*To score this question:*<br>*Tick 'Adequate' if the given answer shows the steps to arrive at the correct answer or gives reasoning for why the answer is true or false, for questions that are above Recall level.*<br>*Tick 'Partially satisfied' if answer given is limited to the correct numeric answer or, simply saying true or false.* | | | | |
| **P10. Is the *diversity among your students* represented in the textbook and digital support (for e.g. socio-cultural/ gender/linguistic diversity)?**<br><br>*To score this question:*<br>*Tick 'Adequate' if you find the content in the textbook and support materials cover the diversity among your students in terms of gender, religion, economic strata etc.*<br>*Tick 'Partially satisfied' if the textbook and support materials miss addressing any of your student diversity characteristics.* | | | | |
| **P11. Are conversational style and *human-like characters* (e.g. Bhoojo and Paheli in NCERT textbooks) *used to* communicate with students*?***<br><br>*To score this question:*<br>*Tick 'Adequate' if textbook and digital support satisfy the following points: uses a) conversational style (such as 'us' and 'we'), b) human-like characters to communicate with students.*<br>*Tick 'Partially satisfied' if any one of the points is not satisfied.* | | | | |

| Pedagogical alignment (P) | 0 (Missing) | 1 (Partially satisfied) | 2 (Adequate) | Remarks |
|---|---|---|---|---|
| **P12. Is the textbook layout well organized, visually attractive and thoughtfully designed to engage the students at that grade level?**<br><br>*To score this question:*<br>*Tick 'Adequate' if all the following points are satisfied: a) the text content, tables and graphics are meaningfully organized and b) there are sufficient number of graphics that will visually attract students and also add to the content explanation.*<br>*Tick 'Partially satisfied' if any one of the above points is not satisfied.* | | | | |
| **P13. Are links provided for digital support that *enhance meaningful learning* of the content?**<br><br>*To score this question:*<br>*Tick 'Adequate' if textbook or teacher manual provides links to digital support that enhances learning of the content.*<br>*Tick 'Partially satisfied' if some of the links to digital support that do not enhance learning but merely serve a cosmetic purpose.* | | | | |
| **P14. Is *guidance* *provided to teachers* on how to conduct student-centred classroom instructions so that the stated objectives are achieved?**<br><br>*To score this question:*<br>*Tick 'Adequate' if all the following points are satisfied: stepwise guidance is provided on a) how to conduct student-centred classroom instruction involving variety of instructional strategies (e.g., teaching with physical models, pair-share activities etc.) and b) how to effectively teach with digital support in the classroom.*<br>*Tick 'Partially satisfied' if top-level guidance is given for the teacher but no stepwise outline on how to conduct the instruction.* | | | | |

| **Technology Integration (T)** | **0 (Missing)** | **1 (Partially satisfied)** | **2 (Adequate)** | **Remarks** |
|---|---|---|---|---|
| **Score** / **Questions** | | | | |
| **T1. Does the digital support balance conceptual understanding with procedural skill and *fluency*?**<br><br>*To score this question:*<br>*Tick 'Adequate' if you feel the digital support addresses a balance of all three abilities stated in the question.*<br>*Tick 'Partially satisfied' if you feel the digital support addresses only a subset of the abilities.* | | | | |
| **T2. Does the digital support include virtual manipulatives (like virtual tangrams, blocks, algebra tiles) or mathematical games to help students test their understanding?**<br><br>*To score this question:*<br>*Tick 'Adequate' if the digital support enables students to interact with it to test their understanding. This can be possible through interactivity features like drag & drop, drop-down, input boxes, slider bars, radio buttons etc.*<br>*Tick 'Partially satisfied' if digital support contains some interactivity features but they are superfluous or, some of the given links do not work.* | | | | |
| **T3. Are the textbooks and support materials, including worksheets, easy to access online, with all of them located in one place for convenience and ease of use?**<br><br>*To score this question:*<br>*Tick 'Adequate' if the textbook and all support materials are accessible online and located at a single place.*<br>*Tick 'Partially satisfied' if either textbook or support materials is not accessible online.* | | | | |

| Glossary of terms | | |
|---|---|---|
| **Question No.** | **Term used** | **Meaning of the term** |
| C1 | **Content accurate** | Content accuracy includes use of precise and accurate mathematics, accurate mathematical terminology and correct concrete or abstract representations (e.g., pictures, symbols, expressions, equations, graphics, models). |
| C2 | **Mathematical knowledge and skills** | i) Mathematical knowledge refers to the syllabus outlined by the board for the particular grade.<br>ii) Mathematical skills outlined by NCF, 2005 covers the following – students' ability to 'think and reason mathematically, to pursue assumptions to their logical conclusion and to handle abstraction, the ability and the attitude to formulate and solve problems'.<br>[Reference: http://ijepr.org/doc/V4_Is2_June15/ij18.pdf ] |
| C3 | **Context** | A context is something that motivates the student to care about the topic. For example, a motivational introductory scenario or a real life example or application may be presented. The context is appropriate when it is relevant and sufficient for the specific content. Like, when teaching geometrical shapes in Grade 2, a picture of a republic day parade can be presented that includes various types of shapes. However, if the picture shows only rectangles, then it is a relevant but insufficient context. |
| C4, P2,P7 | **Formative assessments** | These are questions that appear within the content explanation. Students can solve/do them in class and receive immediate feedback from the teacher. |
| C4, P3, P7, P9 | **Summative assessments** | These are assessment questions like exercises that are present at the end of a chapter. They test the student's understanding about the entire chapter. They are often assigned as homework and teacher feedback is not immediately received. |
| C4 | **Correct, clear, unambiguous** | i) Correct means the question as well as the solution should contain correct facts and accurate mathematical explanations.<br>ii) Clear and unambiguous means the wording of the assessment questions and solutions should be clear and complete for the student, the question should not be open to more than one interpretation. |
| C5 | **Formatting consistency** | Means font sizes, font styles, font alignment like justified text etc. do not vary arbitrarily throughout the textbook and the support materials. |
| P1 | **Necessary** | Means the learning objectives address the Board-specified knowledge and skills - Application (apply concepts independently to new real-life situations), Conceptual understanding, Procedural skill and Fluency (core calculations & mathematical procedures to perform quickly and accurately) |
| P1 | **Stated explicitly** | Means the learning objectives can be written as text in textbook and teaching manual or orally spoken in the digital support. |
| P2 | **Connect multiple concepts within or across subjects** | Connection between multiple subjects should be conveyed to students to understand the relevance of Mathematics in different spheres of life. For example the Rational number system can be discussed in context of the tiger census and interpreted to show the tiger becoming an endangered species.<br>Connection between multiple concepts in Mathematics is required for students to see how one concept is linked to the other. Problem solving can be done that would require students to apply the multiple mathematical concepts learnt. |
| P4, P5 | **Experiments** | Textbook can contain experiments with specified aim and procedure that students can carry out using everyday materials. These experiments can enhance their conceptual understanding of the chapter content. For example, experiment on how to measure the length of a curve with a scale. |
| P6 | **Aligned with the learning objectives** | The formative and summative assessment questions must match the cognitive (Bloom's) level of the stated learning objectives. For example, if learning objective is stated at Apply level, then some assessment question(s) should be at Apply level. |

| Glossary of terms | | |
|---|---|---|
| **Question No.** | **Term used** | **Meaning of the term** |
| P6 | **HOTS** | Higher order thinking skill (HOTS) covers all the levels of Revised Bloom's Taxonomy, starting from the Apply level and above. Ideally, the textbook and the support materials should include those HOTS questions that are important for the topic. |
| P10 | **Diversity among your students** | Students may come from different strata of our society, from different religions, from different genders etc. The textbook and support materials should address this diversity. For example, when mentioning different characters in word problems, the names taken should represent both boys and girls and from different religions or, if given examples involve foodstuff (pizzas and doughnuts etc.) then these foodstuff should be the ones that students are familiar with. |
| P11 | **Human-like characters that communicate with students** | Human-like characters are characters that students can identify with. These characters function as co-learners and are used throughout the textbook. For example, these characters (like Bhoojo and Paheli in NCERT textbooks) can converse about the content between themselves like asking probing questions to each other, discussing the observations from experiments etc. Such characters are known to have positive impact on student learning. |
| P13 | **Enhance meaningful learning** | Digital support will enhance meaningful learning when content involves : a) making the invisible visible like showing the line of symmetry for various given shapes or, b) showing a system that dynamically changes with time or space like plotting the distance travelled vs. time for a moving car. |
| P14 | **Guidance provided to teachers** | Stepwise guidelines provided for teachers on how to conduct student-centred in-class instructions based on established protocols of active learning strategies. |
| T1 | **Fluency** | Mathematical fluency means to be able to perform core calculations & mathematical procedures quickly and accurately. |