

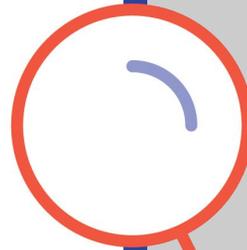
EdTech

Tulna

EVALUATION REPORT

MATIFIC

MATHEMATICS
GRADES K-2



Evaluated in
September 2021

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1. What Does This Report Contain?

The section, 'Overview of the Product', provides a brief description of the product and its key features to give the context for the evaluation. The two sections following that present the findings from the evaluation. The Executive Summary provides the overall rating and offers implications in terms of benefits and limitations for teachers and learners. The Detailed Review section provides an in-depth evaluation of the product, categorized under three dimensions (or constructs) – Content Quality, Pedagogical Alignment, and Technology & Design. For each dimension, the product is reviewed on the criteria along with explanations for the rating, and grouped into clusters. Specific examples have been provided in this report to support and elaborate on the evaluation ratings.

The terms, 'Exemplary', 'Valuable', and 'Potential to Improve', used in the report refer to the rating scale for evaluating the product.



'Exemplary' indicates that the product has been designed as per recommended learning theories and research-based evidence.



'Valuable' indicates limited adherence of the product's design to the recommended learning theories and research-based evidence.



'Potential to Improve' indicates unsatisfactory or lack of adherence of the product's design to the learning theories and research-based evidence.

2. Overview of the Product

Matific is a personalized and adaptive Math learning platform for grades K-6. It presents learners with play-based activities aligned to the National Curriculum. It can be used independently by children as the learning activities adapt according to the level and the performance of the learner. The product also has features that make it suitable for use by schools and teachers to supplement their classroom teaching. This report evaluates Mathematics for Grades K-2.



3. Executive Summary

Matific | Mathematics | Grades K-2

Content Quality
Exemplary



Pedagogical Alignment
Exemplary



Technology and Design
Exemplary



Potential benefits of this product

Learners will likely be able to-

- Engage with the content deeply due to exemplary cognitive engagement and motivational features
- Solve difficult mathematical problems due to exemplary constructivist pedagogy approach and learning scaffolding in the product.
- Use the content for practice activities as the content is accurate and aligned with the NCERT curriculum.

Teachers will likely be able to-

- Use game-like activities as assignments to support classroom teaching or use it as an out-of-class component in a flipped-classroom mode
- Assign game activities to learners based on their performance since the product has an exemplary dashboard

Potential limitations of this product

Learners will likely face the following issues

- Get frustrated with the learning activity since for some of the activities the interface design is not intuitive and the learner has limited control over the learning path.
- Learners with different needs are likely to disengage due to limited adherence to universal design guidelines.



Matific (Grades K-2): Summary of Review Ratings by Criteria

Content Quality: **Exemplary** 

C1 Content accuracy	Not applicable as the product did not contain separate content videos or text; instead “content” in the product was entirely in the form of questions.	
C2 Correctness and clarity in assessment	The assessment questions are clear and solutions contain accurate explanations for all the topics.	
C3 Language comprehensibility	The language, accent, and vocabulary are easy to follow	
C4 Mathematics skill coverage	Mathematics mindset and skills required for grades K-2 (recommended by NEP 2020 and NCF) are covered.	
C5 Curriculum alignment	The content is aligned to NCERT and logically sequenced.	
C6 Inclusivity in representation of learners	No consideration is given to include diversity in terms of gender, socio-economic class, religion, etc.	

Pedagogical Alignment: **Exemplary** 

P1 Constructivist approach	The learner has enough opportunities for problem-solving and to make sense of the concepts.	
P2 Addressing learning gaps/ alternate conceptions	Potential learning gaps have been identified and addressed in some topics but are missing in others.	
P3 Content in context	All of the topics have some real-world context and it is sufficient as well as relevant.	
P4 Learner scaffolding	Sufficient scaffolds are provided to help learners form mental models of the concepts	
P5 Cognitive engagement	The content presentation style is conversational and important points are highlighted.	



P6. Motivational features	Features like the points system, mastery level, and challenge questions keep a learner motivated.	
P8 Learning objective – assessment alignment	The assessment questions are aligned to the learning objective of the learning unit.	
P9 Pedagogy – assessment method alignment	Some learning units have pedagogy and assessment aligned to grade-level NEP recommendations, such as play-based learning, but this is missing in some learning units.	
P10 Cognitive levels covered	Sufficient Higher Order Thinking Skills questions are present.	
P11 Feedback Quality	Feedback is inconsistent across learning units	
P13 Adaptivity	The system adapts to the learner’s performance and profile.	
P14 Teacher support	Robust supports for creating homework, worksheets, and dashboards to track student progress are available.	

Technology and Design: Exemplary

T1 Interface design: Enable intuitive use	The product interface enables intuitive use. However, there's inconsistent guidance for learners on how to use the interface	
T2 Interface design: Assess consequences of an action	User Interface provides appropriate feedback to learner’s actions.as well as facilitates recovery from error.	
T3 Learner navigation & pace	The learners have complete control over the selection of topics and activities, but within the activity learning path is decided by the system and learners cannot go back to the previous question	
T4 Universal Design	Several Web Content Accessibility Guidelines and principles have been followed. However, the product did not have low entry barriers for diverse learners such as learners with varying abilities, special needs, or other special characteristics.	
T5 Analytics for learners’ progress	The dashboard has useful information for the teachers and learners,	
T6 Tools to support problem solving	Product provides tools to support problem-solving.	
T7 Meaningful interactivity	All necessary interactivity features are included in the activities of the product. They are meaningful for learning the content.	

4. Detailed Review

4.1 Content Quality

Content Accuracy and Clarity	8
Alignment to National Standards	9
Inclusivity in Content Representation	10

4.2 Pedagogical Alignment

Learner-Centred Approach	11
Enhancing Learner Experience	14
Assessment of Learning	19
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4.3 Technology & Design

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Content Quality
Exemplary

4.1 Content Quality

Content Quality measures the accuracy and content/skill coverage for the grade targeted and the specific domain. This dimension focuses on content accuracy and clarity, alignment to national standards, and inclusivity in content representations.

4.1.1. Content Accuracy and Clarity

Correctness and clarity in
assessment (C2)

Language
comprehensibility (C3)

Correctness and clarity in assessment (C2) is rated Exemplary.

Most of the content is completely correct and clear. The questions clearly state and demonstrate the response or the action which is expected from the learner. Simple animation is usually present at the beginning of an activity which helps the learner understand and get familiar with the ways to respond and interact for the task. The solutions are accurate and accommodate multiple possibilities for the correct response.



Illustrative example:

- Grade K, *Spatial Words*: For example, “Place object A above B, and object C to the right of A”. Many different possibilities are possible and are all accepted.
- In *Identifying Shapes*, all shapes (like squares, triangles) in different orientations in a given painting are identified correctly.

This is observed in each activity where multiple correct responses are possible.



Language comprehensibility (C3) is rated Exemplary.

Most of the learning units have a simple and minimal sentence structure and use simple vocabulary appropriate for the grade range. The presence of a lot of visuals in the form of images and animated visualizations make the content comprehensible.

There is a voice-over to listen to the written text for learners who might find it difficult to read. The voice-over can be played and repeated multiple times. Some types of sentences used are described below.



Illustrative example:

- "How many fish are there?", "Click on 5 birds".
- "How many total fruits are there?"
- "Tree is ___ blocks tall"?, " Which is taller"?
- Put 20 apricots in the box. How many flocks did you see? How many acrobats are there?

Although some vocabulary words (like meerkat, apricots, acrobats) might require some effort, the sentence structure is very simple and the content is usually supported by images, which might resolve any difficulty faced by the learner.

There is one unit in Grade K, "Shapes and Spatial understanding", where the language requires effort to understand and must be made simpler for a kindergarten learner to be able to understand if they are attempting the activity independently.

- "Hand the double bass to the musician under the bird wearing sunglasses"

Since the product is designed to be used in-class at a particular time in a lesson, the learners also have a teacher to instruct them and help them in understanding the activity. Instances like the above are expected to be resolved in that situation without affecting the learning process.

4.1.2 Alignment to National Standards

Mathematics Skill coverage
(C4)

Curriculum alignment
(C5)



Mathematics skill coverage (C4) and curriculum alignment (C5) are rated Exemplary. It is observed that, broadly, all the topics and activities covered were aligned with the content present in NCERT textbooks for Grade K-2. Important skills like understanding shapes & patterns, data handling, measurement, money, and number systems have been covered. There is strong evidence of scenario-based teaching and real-life examples used across the product. For instance, for teaching maps and navigation, the learner has to deliver pizza to different locations like houses, parks, hospitals, etc. Another excellent example of real-life scenarios is while teaching angles, the learner is the captain of the ship who has to guide the ship to the island by selecting the right angle which involves additional skills like estimation and sense of direction as well.

The chapters are chunked into smaller topics that are logically sequenced and aligned to the curriculum. Each topic consists of several activities and worksheets which are supplemented with a detailed and scripted lesson plan which can be used by the teacher at school. Most of these activities and worksheets are in alignment with the corresponding NCERT curriculum and help create deeper understanding within these topics.

4.1.3 Inclusivity in Content Representation

Inclusivity in the representation of learners (C6)

Inclusivity in the representation of learners (C6) is rated Potential to Improve.

No specific attempt or an effort has been made to represent different genders, races, religions, skin color, but neither is there any bias. The Indian context is overall lacking. Some examples are listed below.



Illustrative example:

- In Grade K, Musical instruments like “Double Bass”, “Maracas”, “Party Horn” were used casually.
- Animals like Meerkat and Hedgehogs are used. Beverages like ‘Sorbet’ are also mentioned.
- Indian currency is not used in the chapter on Money.

Some activities do use relatable objects, like common fruits and vegetables, settings like birdhouses and marketplace or robots in a spaceship, but there is no intentional effort to represent different sections of the Indian society.



Pedagogical
Alignment
Exemplary



4.2 Pedagogical Alignment

Pedagogical Alignment focuses on adaptivity, learner-centered pedagogy, enhancing learner experience, assessment of learning, and teacher support. It measures the extent of alignment of the pedagogical strategies with national educational policies, Learning Sciences theories, and design principles to create a meaningful learning experience.

4.2.1 Learner- centered Approach

Constructivist approach
(P1)

Addressing learning gaps
(P2)

Constructivist approach in pedagogy design (P1) is rated Exemplary.

The product follows a constructivist approach, with a high element of interactivity, experimentation, and visualization. In many activities, the learner is required to perform some actions to achieve a particular goal. In a series of questions, the next question is sometimes based on an activity the learner performs, making the learner very actively involved in the process. The learners understand and form an intuitive understanding of the concept during the process, without explicitly being taught about it.



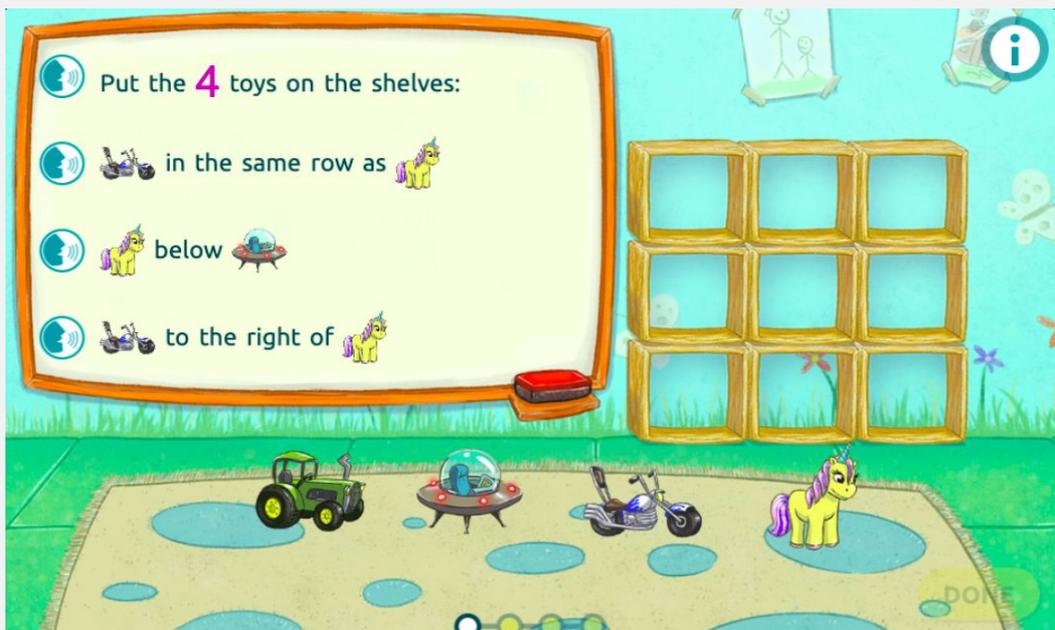
Illustrative example: Topic: Addition, Grade 2

- String a bead: The learners make a necklace with different types of beads and then count the total beads in the necklace.
- Hop-a-bus: Learners keep a track of the total number of passengers by counting how many get on the bus at each stop.
- Some direct addition practice problems are then presented to make the learning concrete.

Problems are asked in different ways, placing different constraints within a setting and hence providing sufficient opportunities for problem-solving. This also serves to accommodate different mental models and different ways learners might make sense of the same concept.

**Illustrative example:** Topic: Spatial Words, Grade K

Objects are to be arranged on shelves while following certain constraints on the relative positioning of the objects. Multiple possibilities are accepted. As the learner progresses, there are more constraints introduced.





Illustrative example: Topic: Counting and Collection of Objects, Grade K

Objects to be counted are presented in multiple ways, sometimes present in a straight line or arranged as an incomplete pyramid. This helps the learner to connect different ideas and concepts together. They may notice that a pyramid consists of 10 acrobats and use this to find the total.

Apart from the above examples, a lot of such interactivities are observed in almost every learning unit. Overall, the activities are designed to address different aspects of a concept, with enough opportunities for active problem solving, which also helps address some potential learning gaps.

Addressing learning gaps / alternate conceptions (P2) is rated Valuable. The common learning gaps have been identified as well as addressed very well in many of the topics. The proper visualizations in the feedback also help the learner realize their alternate conceptions and understand their possible learning gaps.

In many units, a concept is looked at from different perspectives and meaning which resolves any potential learning gaps, which the learner might have.



Illustrative example: Topic: Subtraction, Grade 2

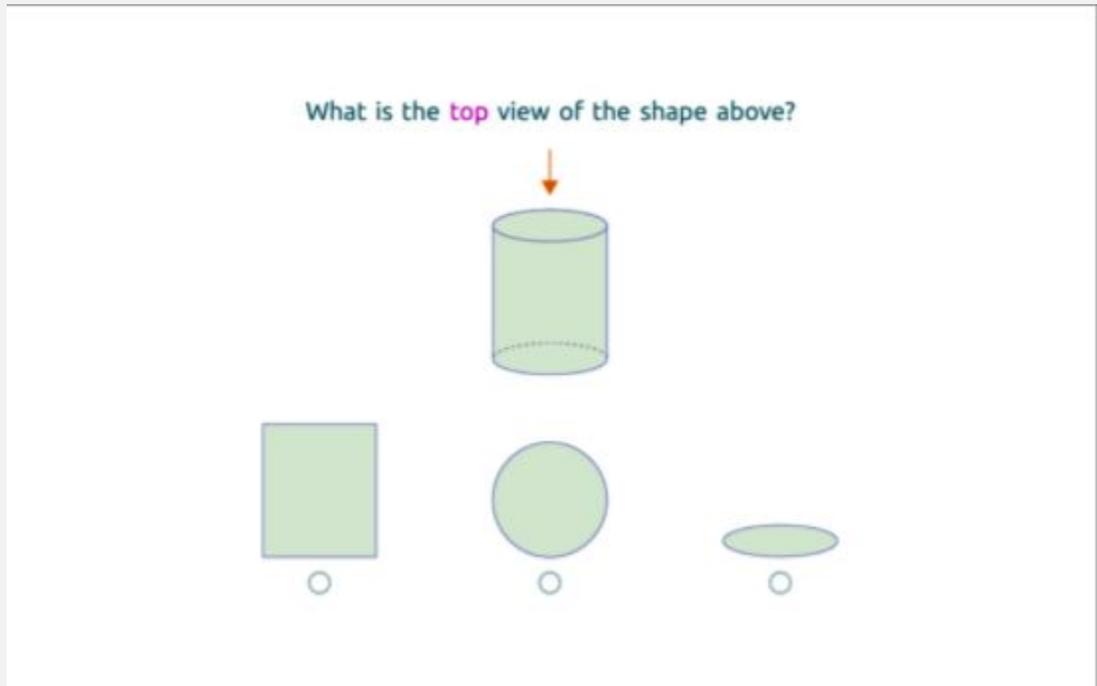
- **The idea of remaining objects:** Cherries are displayed on a plate, and learners count them. A monster then eats some of the cherries, and learners determine how many it has eaten by counting how many remain on the plate.
- **Simulation of subtraction:** Learners can simulate the subtraction operation by removing birds from the compartments and counting the birds remaining.
- **Correspondence:** “How many more bees there are than flowers?” They can drag bees onto the flowers, which creates a one-to-one correspondence between bees and flowers and reveals how many unmatched bees remain.

Some other direct and explicit learning gaps are also resolved by presenting appropriate questions and tasks to the user.



Illustrative examples

- Grade 2: In the unit of length, There are examples involving different starting points of objects while comparing lengths, which addresses a potential learning gap.
- Grade 2: In the worksheet on identifying different views of 3D solids, the top view of the cylinder, one of the options is an oval-like shape. This addresses the general alternate conception regarding 3D shapes, and makes it clear that what might be visible from a particular view might not be the same when viewed from elsewhere.



However, there are a few learning units, mostly observed in Grade K where some potential learning gaps have not been addressed sufficiently.

- For example, 'place a to the right of b' and 'put a and b' in the same column, have similar visual feedback. So, learners might think that these are the same ideas.
- Some learning gaps are identified but not resolved well enough. For example, Identifying a square in different orientations. A visualization to help understand how they are also a square is missing.
- The idea of "Subtracting smaller numbers from larger numbers" or the dilemma with it, is not identified.
- In writing digits, even an incorrect scribble of a digit is accepted by the system.

4.2.2. Enhancing learner experience

Content in context
(P3)

Learner scaffolding
(P4)

Cognitive Engagement
(P5)

Motivational Features
(P6)



Content in Context (P3) is rated Exemplary. The product introduces the content to the learner through a gamified virtual context in the world of monsters. As soon as the learner logs in, they are presented with a challenge to help the monster families to unite by solving various mathematics challenges and riddles on the map. Throughout the learning journey across grades K-2, the context of monsters has been very well utilized in designing the learning activities i.e a relevant and sufficient context is included in the content, wherever required. The real-world objects have been used in the activity scenarios within the monster world such as - *Trees, Toys, Snails, Fishes, Houses, Bushes, Hen, Chicken, Cucumbers, Carrots, Pencils, etc.* Routine activities such as *Arranging toys, Shopping, Movies, Farming, Planting, Musical Bands, etc* have been blended into mathematical scenarios. The product very well identifies the real-world application of the mathematical concept in each case.



Illustrative example: Topic: Relative Position, Kindergarten

The activity involves the learner arranging the toys on the shelves as instructed - “Put Toy A above Toy B” or “Put Toy A besides Toy B” - The learner is supposed to drag and drop based on the instruction. This activity is very relevant for Kindergarten kids, as they come across this in their daily lives.



Illustrative example: Topic: Writing Digits, Kindergarten

The activity involves the learner writing the digits, the hand movement of writing the number has been simulated, hence the learner will be able to relate. The context of writing digits in different settings has been simulated i.e. Writing on paper with a pen, canvas with a brush, beach using a stick, and using the finger on a paper.



Illustrative example: Topic: Addition, Grade 1

In this activity called ‘Hop on the bus’, the learner is supposed to count the number of monsters in the bus, different number monsters hop on the bus at different stops and the learner is supposed to add and count the total number of monsters. The school bus scenario is very relatable for Grade 1 students.

The context presented in every topic is very relevant and helps the learner to understand its application and also care about the topic. In the learning unit of **Money (Grade 1)**, The concept of money was introduced using a real-life scenario of shopping in two different contexts introducing the concept of money - **i) Buying toys:** The learner selects a toy of their choice and pays, **ii) At the movies:** An end-to-end movie experience was simulated in the learning activity involving the learners in buying tickets, popcorn, drinks, snacks, etc using virtual monster world currency coins. Overall, the product caters to various aspects of contextualizing the content, and the virtual world created within the product is highlighting various applications of Mathematics in the real world.



Learner Scaffolding (P4) is rated Exemplary. The product provides learners with scaffolds to help the learner form the correct mental model of the concept. Activities are supported with visuals, animations, and pointed feedback that scaffold the learner to visualize and understand the concept better. The activities within a learning unit progress from simple to complex allowing the learner to gradually learn. Complex concepts are broken down into simpler components to help the learners,



Illustrative example: Simple to complex graduation of topics

In Kindergarten, the learning unit of 'Arranging Toys' first starts with arranging 2 toys relative to each other, followed by 3 toys. Similarly, the number of constraints increases as the activity progresses further. Similarly, in the counting activities, the progression is from 'Count up to 5' to 'Count up to 10' This allows the learners to build the correct mental model as they grasp the concept gradually in increasing complexity.

The learner is provided with three attempts to answer any question or perform an activity. In some cases, the system adapts with some scaffolds with the learner's response. If the learner doesn't answer it correctly the first time, the system prompts the learner with a hint or highlights objects/numbers that need some part of the activity to help the learner come out of the stuck situation to give another attempt. There is a repetition in progression if the learner doesn't answer it correctly in the second attempt. With the third wrong attempt, the system presents the correct step-by-step solution, in most cases using an animation. Hints are presented in intermediate attempts. In some cases, the system partially solves the steps to enable the learner to reach the answer, for example, helps identify the dimensions of the rectangle so that the learner is able to calculate the area.



Illustrative example: Topic: Measurement, Grade 1

The Activity involves the learners measuring and comparing the heights of various objects at a farmhouse. Wooden logs/sticks of different sizes are given as a non-standard measurement reference to measure and compare the heights of various objects. A demo animation about how to use these sticks/logs to measure the height of the object has been shown.



Illustrative example: Topic: Subtraction without Borrowing, Grade 2

In the activity called 'Busy as a Bee' - learners are provided with an excellent animation-based scaffold as they're given a task to calculate 'How many more flowers than the bees?'. If the learner gets it wrong the first time, the bees fly to the flowers, align themselves to the flowers so that the difference between the flowers and bees objects becomes easier to visualize. As the learning unit progresses further, they problematize by adding more objects and fading this scaffold.

Some activities have some advanced level scaffolds such as reflective scaffolds which prompt the learner to reflect and build an understanding of their topic.



Illustrative example: Writing Digits, Grade 1

The activity involves the learner in writing the digits (0-9), the hand movement of writing the number has been very well scaffolded. First, the system provides demo animation to explain how to write the letter (using the finger). Second, the learner writes in the section with the outline shape of the letter and traces on the dotted line with arrows, these help learners to practice. In the third attempt, the learners are provided with a rectangular area without any support for tracing. This step-by-step scaffolding and the gradual fading are exemplar examples of scaffolding in the product. All iterations are logged and the learner can reflect on their own creations at the end of the activity. At the end of the activity, the learner can pick their favourite and mark it with a crown.



Cognitive Engagement (P5) is rated Exemplary. The product has paid careful attention to cognitively engage the learners throughout their learning journey. The content presentation style is conversational and the important points in the content explanation are highlighted for the learners to enhance their cognitive engagement with the content. The consistent conversational style is maintained through the virtual context of monsters, in every activity, the monster (avatar) is engaging with the learner to explain various aspects of the activity. Most activities involve the learners in doing the activity, as as they are a part of the story it keeps them engaged. There are many visual cues provided such as highlighting the important text in the question using a different color, important elements, or objects under consideration have been highlighted consistently. For example - if the activity requires the learner to count the number of screws, the learner can mark and highlight the screws to reduce the cognitive overload. Activities are supplemented with voice-overs as verbal cues. The graphics used to simulate the monster world are very realistic and would be highly engaging for the learners.

Motivational Features (P6) is rated Exemplary. The product includes various intrinsic and extrinsic motivational features that are well integrated and hence have the potential to prompt learners to further explore the content. The overall virtual context set to engage the learners is motivating for the learners, the learners are given a responsibility to solve various mathematics challenges to bring the monster families together, the learner is intrinsically motivated by posing questions like "Are you brave enough to solve the match challenges? Can you bring the family back together?". This instills a sense of responsibility to finish the challenges and explore the content further.

The system has points that are collected in the form of 'stars'. If you get the perfect result in the activity the learner receives 5 stars. In an animation at the end of the activity, there is a treasure box that opens and collects the stars. As the learners advance further they collect various monster cards such as 'Medu', 'Jam', 'Shalpi' on completing the activities perfectly. Every time the learner gets an answer correct, there is a star confetti feedback along with a nice motivating sound. On the other hand, if the learner gets the answer wrong there is a 'stuck' sound and is given 3 attempts which motivate the learner to try again and again. The context provided also adds to motivating the student intrinsically, since the learner relates to the topic and understands the relevance and application of the topic. Also, at various instances, the learners are provided with a lot of options to choose from while performing an activity for example choosing the movie, size of the popcorn bucket, etc. This intrinsically motivates the learner.



4.2.3 Assessment of Learning

**Learning objective -
assessment alignment**
(P8)

**Pedagogy-assessment
method alignment**
(P9)

**Coverage of
cognitive levels**
(P10)

**Feedback
quality**
(P11)

Learning objective - assessment alignment (P8) is rated Exemplary. The activities, worksheets, and corresponding lesson plans provided are aligned completely to the learning objective of the topic and its corresponding cognitive levels. The lesson plan also explicitly states the learning objective for each activity, along with an activity overview, description, and behind-the-scenes which describe the purpose of the activity and what it intends to achieve.

Pedagogy-assessment method alignment (P9) is rated Exemplary. The pedagogical strategy used in the product is as recommended for each grade group in NEP, 2020. According to NEP, 2020 - “the pedagogical strategy recommended for Pre-primary Education (Grades 1-2) is Scenario-based teaching-learning through play and storytelling-based pedagogy.” The pedagogical strategies (e.g. activities, examples) used in the product are aligned to the assessment methods used. Excellent play-based and scenario-based pedagogy used throughout all units.

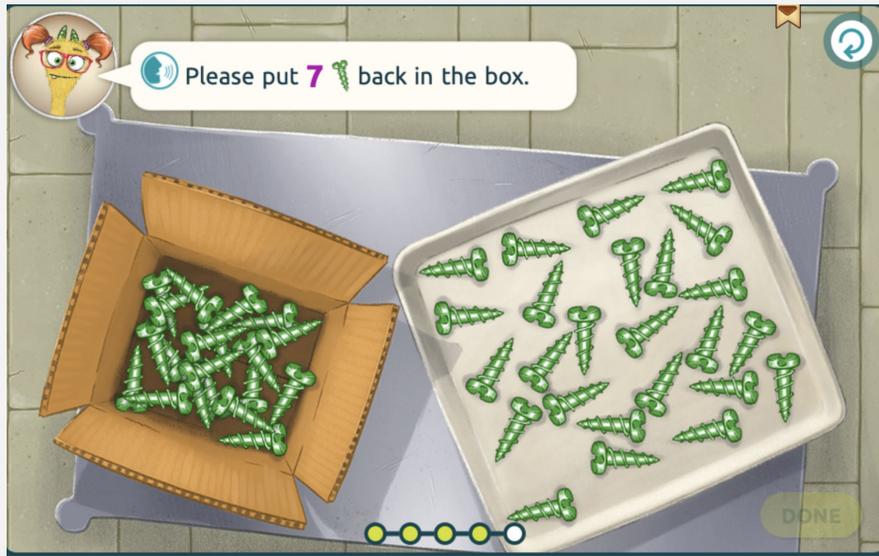
Cognitive levels covered (P10) is rated Exemplary. The questions are present at various cognitive levels as required, ranging from understanding and identifying, to application, analysis, and creation.

There is excellent coverage of Higher Order Thinking Skills (HOTS) questions in a lot of topics, going much beyond just recalling or identifying. The maximum HOTS are at an application level, but there are some instances of ‘create’ level questions as well. Most topics have problems where learners need to apply the concept, solve problems and make connections between different ideas.



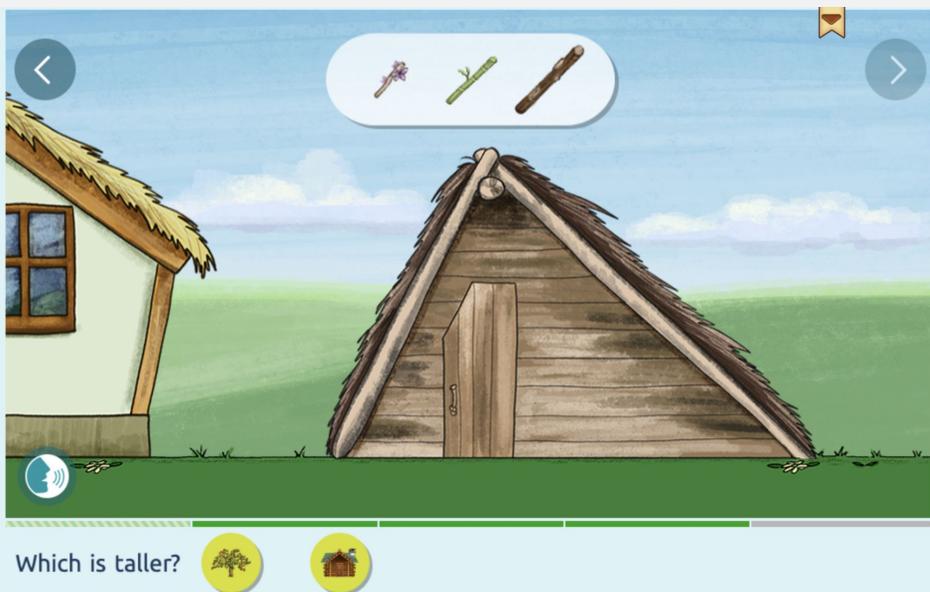
Illustrative example: Topic: Collection of Objects, Numbers - Kindergarten

- In this example (see figure below), a broad range of cognitive levels is covered here. It ranges from just counting - involving identifying/recalling - to applying and actually helping fix an ice cream machine. The learner is supposed to help a monster fix an ice cream machine by doing tasks like ‘Turn on 5 switches,’ place the tubes, bulbs, screws, etc. In the end, the screws are to be put back, requiring some level of analysis/evaluation.



Illustrative example: Topic: Measurement, Grade 1

- There are two activities - 'Tall Timbers,' and 'Made to Measure'. In the case of both activities, the heights of various objects/animals on the farm are compared using non-standard measures like wooden logs and sticks (see figure below). While comparing these heights, the level of the ground is sometimes raised, which means the learner requires to actually use the scaffolds given to check and measure how tall or short each of them are, and they can't do it directly via measuring from the screen and hence have to change the base. This requires understanding and application of the concept.





Feedback quality (P11) is rated Valuable. There is some variation observed in the quality of feedback (P11) provided. For many units, the feedback is excellent and has components like extremely strong signaling as well as visuals for an appropriate explanation. There is also an appropriate use of animations used to explain different concepts in most units.



Illustrative example: Addition without carry-over, Grade 2

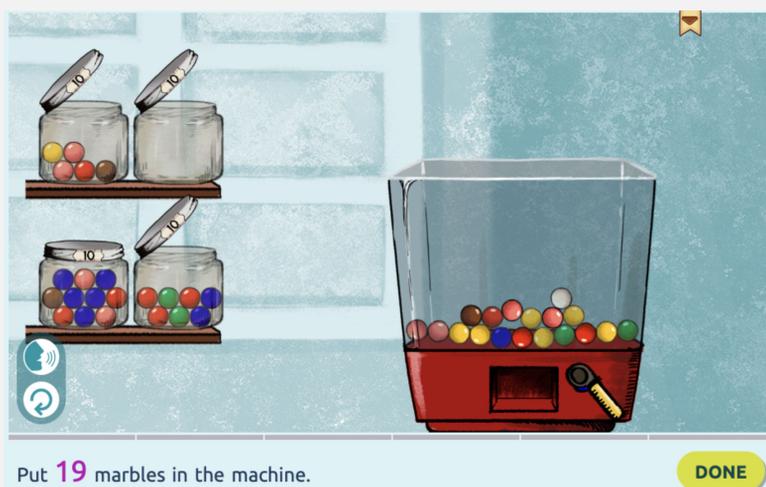
- In this unit, the feedback is very visual and appealing. It helps younger learners understand the concept, as well as be engaged throughout. Also, the feedback is very intuitively designed by using different colors, sounds which help nudge the learner in the right direction. Animated and pointed feedback about which answer is wrong - i.e. the right answer is highlighted green and the wrong one is highlighted red. There are also correct explanations depicting the reasoning present. The 'Make 100' activity also has real-time feedback. System buzzes if incorrect pairs are matched.

However, some units lack good-quality explanations. The aspect of providing remedial content directly in the feedback is completely missing, but this seems mainly due to the assessment adaptive nature of the product. This is somewhat catered to by providing appropriate questions based on the user's performance. In some units, feedback is binary, or not completely grade-appropriate (K-2) as listed below:



Illustrative example: Place Value up to 40, Counting, Grade 1

In the activity, 'Load it Up', the feedback is not adequate, as it doesn't give learners an opportunity to count (see figure below). They just drop 15 balls at once, which doesn't help the learner understand the concept of place value. It is also little or no signaling present to allow the learner to grasp the concept properly.





Illustrative example: Shapes and spatial understanding, Kindergarten

- In the case of 'Strike up the Band', there's no feedback given on the wrong answer. Only the correct answer is shown. In the case of 'Arranging Toys', there are a few constraints given. The feedback is provided via a board to see what is correct or wrong and there is some signaling present while explaining the wrong answer. Words like below and under are used which might not be understandable to a kindergarten student.

4.2.4. Adaptivity

Adaptivity (P13)

Adaptivity (P13) is rated Exemplary. The product adapts dynamically to the learner's profile as well as the learner's performance. A customized learning path with a set of activities is initially laid out for a learner based on their grade. This path keeps updating dynamically based on a learner's performance in the activities. If the activities are done with high accuracy, the following ones are at a higher difficulty level. On the other hand, if the learner makes a lot of mistakes, easier concepts are introduced in the subsequent activities.

4.2.5. Teacher Support

Teacher Support (P14)

Teacher Support (P14) is rated Exemplary. Detailed guidance and lesson plans are provided for the teachers explaining how to integrate any of the activities in their teaching. There is also support for the teacher to create groups of students and assign various activities to different learners, hence creating a customized learning experience for the learners.



Technology and
Design
Exemplary



4.3 Technology and Design

Technology & Design measures how well the technological affordances integrate with the pedagogy and content to promote a meaningful learning experience for all learners. This dimension focuses on user interface design and affordances that facilitate learning.

4.3.1. User Interface Design

Interface design
(T1 and T2)

Learner navigation and pace
(T3)

Universal design
(T4)

Interface design: Enable intuitive use (T1) is rated Valuable:

The Matific activity interface enables intuitive use via the provision of help animations before a learner begins an activity aiding in understanding the usage of affordances provided by the interface.

Even though the product allows intuitive use there are instances in which learners have to figure out which button to press as no guidance is provided for initiating the activity.



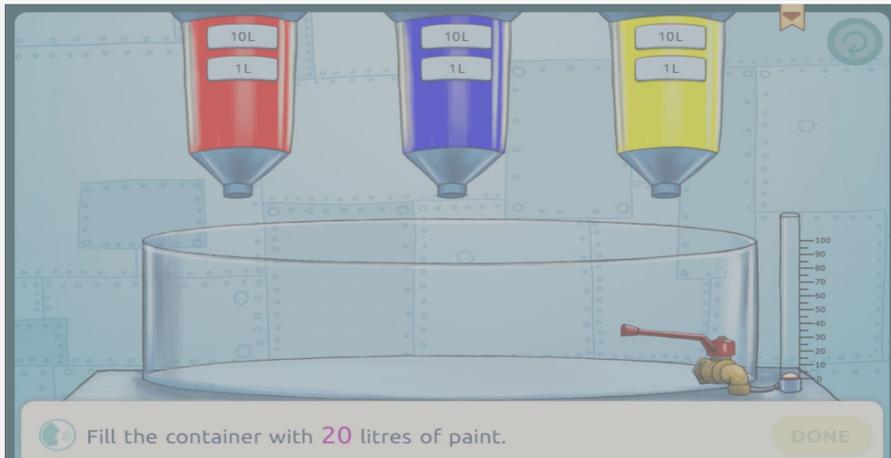
Illustrative example: Topic: Comparing measures, Grade K

The activity provided to choose a tall tree and radio buttons are provided to choose between options that are intuitive and easy to use for this grade range (K-2).



Illustrative example: Topic: Composing 2 digit numbers, Grade 1

The activity is provided to collect paints into a jar for a given quantity (figure below). However, there is no guidance provided for how to proceed with the activity i.e., no sufficient cues available to learners about how to use the visible elements seen on the screen.



Example for non-intuitive interface

Interface design: Assess consequences of an action (T2) is rated Exemplary

Scenarios that cause an error during usage for the Matific interface both at the activity interface, as well as the overall platform level interface, are minimal.



Illustrative example:

A confirmation message is displayed if the user logs out by mistake.

The product's interface provides appropriate feedback using visual cues (the entire question text shakes when a wrong answer is submitted along with a sound) to enable the learner to work through the activities.

Learner navigation & pace (T3) is rated Valuable

Learners are free to navigate across learning units and start from any point. Even within a learning unit, the learner can navigate between activities. However, the learning path within an activity is preset and cannot be changed. There is no scope to ignore feedback and proceed. Navigation back to attempted questions or activities is not possible unless the learner retries.

Universal Design (T4) is rated Valuable

Product is robust in several criteria for universal design like provision of audio and visual content, some key actions can be performed from the keyboard (without needing a mouse), and availability of voiceover option for reading questions. Many expected and important aspects are missing which would help the content accessible to a diverse set of learners. This includes a provision to pause animated content, assistive technology like an NVDA screen reader not recognizing content in activities and the menus on the homepage, cross-browser issues (e.g., with Microsoft Edge), and cross-device compatibility (e.g., iPad logins).



4.3.2 Affordances that Facilitate Learning

Analytics for learners' progress (T5)

Tools to support problem-solving (T6)

Meaningful interactivity (T7)

Analytics for learners' progress (T5) is rated Exemplary. The dashboard provided by the product is very useful and usable for the intended users (Teachers, Students, Parents). The teacher's login allows the teacher to assign activities at the class level as well as at a student level. The information provided by the interface is easy to interpret. It provides information about the assigned work progress, it gives student-wise data about the completion of work-in-progress. It is noteworthy that the dashboard also provides pointed segregated data about 'Students needing help' and the 'Students that are excelling'. This will allow the teacher to give personalized attention as per the need and also assign higher-level activities for the excelling students to cater to their advanced skill development. The dashboard also provides the teacher with daily critical insights at various levels. Overall, the teacher dashboard provides sufficient guidance on identifying where the learner needs to put in the effort or where additional support should be provided to make progress. Similarly, there is a parent dashboard that provides them with the basic progress about their learners' progress and highlights some actionable insights. Learners' progress is visible as they solve the challenges - the 'Training zone' shows their result along with the class average for that particular topic which allows the learners to reflect on their progress and attempt it at their pace.

Tools to support Problem solving (T6) is rated Exemplary. The product provides tools in every activity that learners/teachers would need to solve the given problem, thus contributing to the learning process. The learning activities have embedded tools relevant to the topic to enhance the learning experience. In activities requiring the learner to measure dimensions, a non-standard measurement object (e.g., **wooden log, stick**, etc) is provided to measure the dimensions. This is relevant for the age group as using a scale might be difficult for them. Another example is a **marking tool** provided to allow the learners to mark as they count the number of objects under consideration. This is useful for lower grades when they are learning to count or add numbers.

Meaningful interactivity (T7) is rated Exemplary. The overall product has most of the basic interactivity features which are used appropriately to help the learner move forward with the learning in a meaningful manner. For example, radio buttons and input boxes are the most common ways observed by which the user responds to the questions. All necessary interactivity features are included in the activities of the product. They are all very meaningful for learning the content. No superfluous interactivities have been included. Basic interactivities such as radio buttons, input boxes, drag and drop are the most common ways by which the user performs an action. Most activities in the product include interactivities of different variations to understand the concept by doing.

**Illustrative example:** Topic: Relative Position (Kindergarten)

- Drag and Drop interactivity where the learner is supposed to pick the toy and place it on the shelves as per the instruction. For example, Place Toy A besides Toy B.

**Illustrative example:** Topic: Measurement (Grade 1)

- The learner has to align, measure, and compare the heights of various objects using a wooden log. Drag and drop interactivity is used to facilitate this process of measurement using non-standard measures. The objects are spread around the farm, the learner can navigate by clicking on the left and right arrows to scroll side-by-side.



Appendix

How does the EdTech Tulna evaluation work?

FRAMEWORKS

EdTech Tulna frameworks define a set of standards for quality design of EdTech products. A rigorous and research backed process is established and applied for the creation of various nuanced frameworks. These frameworks are use-case specific to enable transparent and precise, high stakes decision making. The process includes considering existing research literature, feedback from the ground on multiple stakeholder needs and an appreciation for the quality of solutions currently supplied in the ecosystem.

The frameworks are categorized along the three dimensions of Content Quality, Pedagogical Alignment, and Technology & Design to capture a holistic view of the quality of the product design. The frameworks are also made available at varying levels of depth for varying stakeholder needs and range from supporting governments and institutions in making high stakes, rank based, adoption decisions, to providing a brief overview of the key criteria to be considered while designing a product.

TOOLS

Each Tulna framework is accompanied by a toolkit that is specifically designed to guide experts to evaluate EdTech products. These toolkits are customized to the type of EdTech solution, grades, subjects, to drive meaningful and nuanced evaluations. The tools are informed by research as well as iterative empirical study and tested for inter-rater reliability and validity. A typical toolkit consists of rubrics and reviewer guidelines to enable evaluators to interpret the framework and conduct unbiased evaluations. Each criterion within the framework is rated along a three-point rating scale - 'Exemplary', 'Valuable', and 'Potential to Improve' - indicating the level of alignment with expectations laid out in the framework. Toolkits include supporting materials - videos, templates, and example illustrations - to guide experts while conducting evaluations.

PROCESS

Each product goes through a rigorous review process that takes approximately 160 hours for four grade ranges K-2, 3-5, 6-8, and 9-10. Each review team is designed to be independent and neutral. A typical expert review team consists of 3-4 members who are subject matter experts, instructional designers, user-interaction experts, user-experience design experts, and professionals with experience in teaching and implementing EdTech in field settings. Each review team has an anchor of at least one experienced evaluator.

Each member of the expert review team undertakes a two-week long intensive training on understanding the frameworks and the subsequent application of its toolkits to conduct evaluations. For each product, the review team applies a systematic sampling strategy and decides the representative learning units that will be reviewed. The team collectively reviews a subset of the learning units to check for convergence and establish inter-rater reliability. Team members then individually review the remaining learning units. The team finally meets to synthesize key points and takeaways of each review and elaborates their reviews into an in-depth report, which is overseen by the experienced evaluator.

The role of the product company is limited to an initial demo which supports the review team to deepen their appreciation of the intended use of the product, and its scope. The product company is then provided the final reviews and their unedited responses are published alongside the expert evaluations on the Tulna evaluation center.

