**Game Overview**

* Player vehicle is in constant forward motion
* At set points, a multiple-choice maths question will appear that the player must answer correctly to shift up a gear
* In order to choose their answer, players need to switch to the appropriate lane that contains the button
  + Collision of car on button will activate it and check players answer
* Player will either race against time to finish the track, or against AI opponents to be the first over the finish line
* Player can customise their vehicle and a driver (drivers may be farm animals for example)
* Unlock can new customisation options through correct questions answers

|  |  |  |
| --- | --- | --- |
| MECHANICS  (The hard-coded rules of the game) | DYNAMICS  (Potential emergent behaviour that will arise from gameplay mechanics) | AESTHETICS  (Desirable emotional responses) |
| * Win condition (Race)   + Finish the race within the time limit/before AI opponents   + 6 correct answers to finish * Multiple choice * Constant player movement (forward motion determined by answering questions) * Point-to-point movement (switching lanes to answer questions) * Player choice and customisation (through choosing vehicles and drivatars) | * Mental arithmetic or paper calculations * Some players may focus on customising their vehicles and drivatars | * Player satisfaction – From retaining information and increasing their knowledge * Excitement of customising their vehicles and drivatars * Joy when unlocking new customisation options |

*Sources*

<https://www.gamasutra.com/view/news/108415/GDC_Game_Design_Workshop_Mechanics_Dynamics_Aesthetics.php>

-MARKET RESEARCH-

**Demographics, Key Stages and Curriculum**

Key Stage 1 (Years 1 and 2: *5-7 years old*)

* “Ensure that pupils develop confidence and mental fluency with whole numbers, counting and place value”
* “By the end of year 2, pupils should know the number bonds to 20 and be precise in using and understanding place value.”
  + Reading and writing numbers 0 to 20 (numerals and words)
  + Counting up to 100 objects and beyond
  + Read and write number to 100 in numerals
  + The 2, 5 and 10 times tables, plus division facts
  + Learning which pairs of numbers add up to 20
  + Recognising number patterns
  + Odd and even numbers
  + Using a number line
  + Adding and subtracting one-digit and two-digit numbers
  + Doubling and halving
  + Finding a quarter, a third and a half of a shape or quantity
  + Simple mental maths
  + Recognising, naming and describing shapes
  + Using shapes to make models and pictures
  + Finding lines of symmetry
  + Measuring and weighing
  + Addition and subtraction of small amounts of money
  + Knowing that a quarter turn is a right angle
  + Recognising and using mathematical symbols
  + Drawing and interpreting graphs and pictograms
  + Telling the time on an analogue clock to the nearest quarter of an hour (or to the nearest five minutes from September 2015)
  + Naming and describing 2D and 3D shapes

Lower Key Stage 2 (Year 3 and 4: *7-9 years old*)

* “Ensure that pupils become increasingly fluent with whole numbers and the 4 operations, including number facts and the concept of place value.”
* “By the end of year 4, pupils should have memorised their multiplication tables up to and including the 12-multiplication table.”
  + Count from 0 in multiples of 4, 8, 50, 100: find 10 or 100 more/less than a given number
  + Recognise place value of each digit in a three-digit number
  + Compare and order numbers up to 1000
  + Identify, represent and estimate numbers using different representations
  + Read and write numbers up to 1000 in numerals and words
  + Solve number problems and practical problems including missing number problems, using number facts, place value and more complex addition/subtraction
  + Order, partition and round numbers to three decimal places
  + Add and subtract number mentally, including a three-digit number and 1s/10s/100s
  + Add and subtract numbers with up to 3 digits
  + Recall and use multiplication/division facts for 3,4 and 8 multiplication tables
  + Count up and down in tenths
  + Add and subtract fractions with the same denominator within one whole

Upper Key Stage 2 (Year 5 and 6, *9-11 years old*)

* “Ensure that pupils extend their understanding of the number system and place value to include larger integers. This should develop the connections that pupils make between multiplication and division with fractions, decimals, percentages and ratio.”
* “Pupils will be introduced to algebra as a means for solving a variety of problems.”
* “By the end of year 6, pupils should be fluent in written methods for all operations, including long multiplication and division, and in working with fractions, decimals and percentages.”
  + Order, partition and round numbers to three decimal places
  + Negative numbers
  + Factors and multiples
  + Prime numbers less than 100
  + Square numbers
  + Cube numbers
  + All the times tables up to 12x12
  + Add, subtract, divide and multiply numbers of up to four digits
  + Know equivalents between decimals, fractions and percentages
  + Ratio and proportion
  + Basic algebra
  + Problems involving decimals, fractions and percentages
  + Use of brackets, including BODMAS
  + Read and plot coordinates
  + Measure and draw acute, obtuse, reflex and right angles
  + Calculate the sum of angles around a point, on a straight line and in a triangle and quadrilateral
  + Calculate perimeter and area
  + Visualise and describe 2D and 3D shapes
  + Symmetry
  + Reflection and translation of shapes
  + Measure length, mass and capacity
  + Convert units of measurement
  + Tell the time from a 12- or 24-hour clock and calculate time intervals
  + Draw and interpret line graphs, bar charts, pie charts and pictograms
  + Calculate the mean

*Sources*

<https://www.gov.uk/government/publications/national-curriculum-in-england-mathematics-programmes-of-study/national-curriculum-in-england-mathematics-programmes-of-study>

<https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/425601/PRIMARY_national_curriculum.pdf>

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<https://www.theschoolrun.com/ks2/key-stage-2-maths>

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<https://www.tes.com/teaching-resource/new-curriculum-maths-objectives-for-years-1-6-6441395>

<https://uk.ixl.com/standards/england/maths/key-stage-2>

**Competitor Games**

* Toon Math; An endless runner where players collect coins to upgrade their “maths spells”. After collecting a power up, players must correctly answer a math question to activate it.
  + Positive Comments and Reviews
    - Makes practicing maths enjoyable, particularly for those who normally struggle with the subject or do not like the subject
    - Options to change the difficulty level so can scale for different maths abilities
    - Level up to unlock new characters and earn coins while running to upgrade maths spells
  + Critical Comments and Reviews
    - “Skill level required to play the endless runner is too high relative to the maths level”
    - Ads are intrusive and make it difficult to play the game
    - Some ads are inappropriate for the target audience
    - Prompts for payment and in-app purchases which were deemed inappropriate for an educational app for children
* Math Rally; Players must use button controls to accelerate/decelerate and steer their car towards the correct answer for the question at the top of the screen
  + The controls seem quite difficult to use, so I can imagine younger children struggling to play the game however, there is an option to use tilt controls instead
  + Option to buy different cars with coins earned during game
  + Doesn’t appear to be a way to adjust maths difficulty for different ability levels
* Kids Math Car Racing; Players answer the maths questions displayed at the top of the screen – the quicker they answer, the more they pick up speed.
  + Players can select their difficulty (number of answer choices and max answer size) and choose which calculations to include out of addition, subtraction, multiplication and division
  + Options to customise car

**BBC Bitesize: Maths**

* A collection of bitesized interactive content, divided by Key Stages, which help students and children learn and practice different topics of Mathematics.
* KS1 section provides maths resources, divided by topics. By clicking a topic, the user is given a selection of short animated videos that explain the concept of the topic they have chosen. The videos feature cartoon graphics and humour which is catered for 5-7 year olds.
* KS2 follows a similar set-up to that seen for KS1, but the videos are based on a wider variety of topics. The videos are slightly more mature and therefore better catered towards children between the ages of 7 and 11.

[**MathsisFun.com**](https://www.mathsisfun.com/) **and** [**MathPlayground.com**](https://www.mathplayground.com/games.html)

* Websites that feature a selection of games, that focus on different mathematical concepts in order to make learning fun for children.
* MathsIsFun features a more general collection of games, whereas MathPlayground features a collection of games that are divided by both topic and school grade.

-IDEAS BASED ON MARKET RESEARCH-

* The game should be targeted towards Lower Key Stage 2 children (ages 7-9) and include questions that allows them to practice up to their 12-multiplication table.
  + The game could have options which allow it to be catered for children in Key Stage 1 (ages 5-7) if time allows.
* Players may be able to toggle which operations are used to focus their learning e.g. if a child particularly struggles with division, they could toggle only this to practice more