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*Handbook for Teachers*

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# The Concept

This is a game about practicing mental math to improve the player's ability to recall arithmetic facts instead of having to work out the answer.

In our modern world we rely more and more on computers to act as extensions of our minds. Whether you want to rewire a plug, translate a foreign word, or find out how long it takes light to reach from the sun to our planet, all the answers are just a quick Google away.

Is there any value in memorising basic mental math operations any more?



The power of just knowing the answer to simple math operations lies in what it frees our brains up to do. The only way we can think through hard problems successfully is by holding the different parts of information in our memory as we process it. Most people can only 'hold' somewhere between 3 and 5 different 'chunks' of concepts or numbers in memory at any time.

People who can't recall the answer to simple arithmetic like "what is six times seven?" might have to actively think about the answer and work it out. This takes up precious working memory, slowing down the thinker and possibly even leading to mistakes.



"Well, five sevens is half of seventy, so that's thirty five - and then you add on the last seven so that's forty two."

A recent study (<http://www.jneurosci.org/content/33/1/156>) found that high school students who relied on their memory for basic arithmetic instead of having to work out the answer performed better on their actual standardised math tests. Math skills developed early in life correlate strongly with later achievement (<http://discovery.ucl.ac.uk/10005971/1/Duckworth2007SchoolReadiness1428.pdf>) so anything we can do to help young people improve their maths skills is worth doing.

In this game players go on an adventure in a magic school, where maths itself is magic. By casting spells (by drawing numbers on the screen with their finger) players practice dozens of arithmetic facts whilst having a challenging but exciting time.

# The Role of the Game



There are hundreds of math games available and as a teacher, it can be hard to find the right game for your class and pupils. Enchanted Crystals can be used in many ways but its strengths lie in giving players a challenging but fun way to practice mental maths skills that young people often struggle to engage with.



It doesn't teach players how to do the sums. But it gives dozens of chances to cast spells using arithmetic that motivate players to perform more operations than a boring worksheet would.

The game is played on mobile phones and tablets. Most children have these at home even if they don't have access in class. Why not give the whole class a challenge to beat the game instead of homework one week? Or how about starting off the new term with a fun refresher of arithmetic through the game?

The game has settings so you players who are slower at mental maths or who struggle with higher numbers can play as well as those who need a challenge. Each pupil will get a score after playing so they can measure their progress. Even after finishing the game, they can go back and try to do better next time.

In this handbook you'll find lesson plans that detail how real teachers like you have used Enchanted Crystals in their classes but the best way to get to know the game is to just download it and play for yourself.

Happy gaming!

# Who is this game for?



## Everyone

If you want to get better at mental arithmetic, this game can help. You love mind games? or math in general? Then this game is also for you. It doesn't matter if you are 8 or 80. If are 8 you get better and if you are 80 you can stay good! Basic maths knowledge is important to all ages. When it comes to maths, kids, parents and grandparents speak the same language. Schools can use the game as homework.

You will have an easier time asking your kid to study a little more. Younger kids will benefit the most with this App because it was made thinking especially of them. When learners get better in the basic operations, they will be also better at more complex math problems, because once you know the basics automatically, it frees up your brain to think about harder things.

## Students

Are you are having trouble with math operations? Practice makes perfect! You can get better with less frustration. Your math skills will improve while you are having fun. More fun equals more results. Share your progress with your friends and family. Bring the game to school and show it to your teacher.



## Parents

You want to be the best parents for your children. This game can help you connect with them in an all-new way. It will be easy for you to ask your child to study a little more. You can both study and have a moment at the same time by playing the game. You don't need to be good at gaming. it's not about clicking the mouse very fast or remembering the buttons on the gamepad. You already know how to play and that's all you need to participate in your child's learning. All the family can play the game and have fun with it.

You can share the screen of the smartphone on the smart TV and all can participate in the game. Make it a social experience, bring the math to the living room. You can witness your child's evolution directly or by their progression in the game. This app will allow you to know more about your child's math skills.



## Teachers

You need all the time you can get. The game can help by supporting fun homework tasks. You may be asking your students to play more, for a change. The kids will train basic math operations at home, freeing up class time to focus on more complex problems and needy students. The teacher can follow students high scores and create scoreboards. Some student's difficulties in basic math operations will become more explicit and you can focus more on them. You can organize contests on the school and create math for fun culture. Math can be fun and you can teach it in a pleasure way. If students get better at basic math operations the rest of the curriculum will be easier to teach. The game also will facilitate your relation with the parents. You can suggest that they will be helping their children by playing with them.

# The World of Enchanted Crystals

## Crystals

The best way of experiencing the world of Enchanted Crystals is simply by playing the game. However, you might like to have a bit of background about the setting and story before giving it to your students. The story can help immerse the players in the world of Enchanted Crystals, which helps make practicing maths fun!

The game takes place in a school, the Academy of Magic, where pupils learn the art of casting spells by shaping magical energy. Spells are cast by manipulating the magical energy in various crystals and bringing them together in different ways. The magical operations are essentially mathematical operations.



## Heroes



**Iona** - She finds herself in a sticky situation and has to use her magic skills to help her escape her situation and save the academy. She is one of the two characters that are played during the course of the game. The only person who she can contact while trapped in the catacombs is her classmate Ramon. However, they don't start off as friends. She finds him stuck up and irritating.

**Ramon** - This young wizard in training is a classmate of Iona's and the other character you play in the game. He's a bit more responsible in getting his work done than her and is just a tiny bit arrogant about that. Despite his attitude, he helps Iona during the course of her adventure, doing research and trying to get the help of teachers.

## Teachers



**Miss Cordis** - This mysterious masked teacher always seems a bit distracted, as though her mind is in another world. She is very good at her job, however, and is the teacher who shows Ramon how to freeze monsters. No one knows why she wears that mask but she's definitely good to have on your side.



**Mr Yorn** - Professor Yorn is a kindly, elderly wizard who teaches the children the light spell at the beginning of the game. He is absolutely devoted to his dog, Mr. Fluffles.



**Miss Mileena** - Though usually friendly and informative, lately something has changed. Iona catches her performing some sort of shadow magic in the halls, and she tosses the hapless student into the catacombs in retaliation! Whatever she's up to, it will take a lot of digging to find out.



**Mr Wadsworth** - This teacher has great bone structure. In eons past he was an instructor at the Academy of Magic, but now he chills out in the catacombs below. He gives Iona helpful advice, as well as teaching her the Stag Leap spell.



**Librarian** - Miss Maron is a fastidious and organised, as one might expect from the librarian. She demands the students are quiet and respectful in her library, but is always happy to share what she knows and help the students use the library to its fullest potential. She helps Ramon find the Frozen Paths spell and discover green crystals.



**Mr Garryn (Headmaster)** - For Headmaster Garryn, everything is a learning opportunity for his students, even his own captivity. He calmly encourages Iona to give her all towards ending the crisis at the academy, as well as teaching her how to detect magic.

**Headmasters** - This collection of headmasters from the academy's past are gathered in a chamber deep under the school in the catacombs. They aren't a bunch of "numbskulls" though, they have some insights to share with Iona to help her solve the mystery and escape her predicament. They let her know she should find the portal that lies further within the caverns and close it if she has any hope of saving the school.

## Background Story



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### The Academy

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## The Levels

### Tutorial – Mr Yorn’s Magical Arts Class

After a disturbing encounter with Miss Mileena, Iona stumbles into the classroom where her classmate Ramon asks her if she created the magic lantern they were supposed to make for homework. The teacher, Professor Yorn, asks the class to settle down so he can teach everyone how to cast the light spell. This level is a tutorial that teaches the player how to combine crystals and create a flame. It introduces the Light spell which is a simple addition of the red and the yellow crystal.



Spells used: Light

Mathematical operations used: +



### Level 1 – Into the Catacombs

Miss Mileena isn't done with our hero yet! She returns to the class to drag Iona to the catacombs, trapping her there. With only her wits, her knowledge of magic, and the help of her classmate Ramon, talking to her via the magic lantern, she must find a way to escape. Iona must first remember how to light up the pitch dark area. In an abandoned training area she discovers the old scrolls that teach the Break spell so she can learn to break down a bricked up passageway and go further.

This level introduces the Break spell which works by dividing the yellow crystal by the red crystal.

Spells used: Light, Break

Mathematical operations used: + ÷





### Level 2 – Searching for the Headmaster

Once Iona contacts him to tell him of her predicament, Ramon goes to find the headmaster to tell him what has happened. Too bad the office is on a higher floor and there are not any stairs sitting around to be used. Ramon has to use the Escalate spell to let him climb to a higher level. Once he is on the correct level, he is still not out of the woods! There is a terrible monster blocking his path. Good thing Miss Cordis is there to teach him the Freeze spell. Once in the office, Ramon finds the place ransacked and the headmaster is nowhere to be found.

This level introduces the Escalate spell which is triggered by multiplying the yellow and the red crystal and the Freeze spell which works by subtracting the red crystal from the yellow crystal.

*Spells used: Light, Escalate, Freeze*

*Mathematical operations used: + - ×*



### Level 3 – Bones

Once again we return to Iona, who is still trapped under the school. Despite the scary setting, she finds an ally in Professor Wadsworth who directs her to where more information might be found, as well as teaching her a new spell, Stag Leap. He also gives her a green crystal which is essential for more advanced spells.

This level introduces the Stag Leap spell which is triggered by adding the green and red crystals.



*Spells used: Light, Escalate, Freeze*

*Mathematical operations used: + - ×*





### Level 4 – Finding Professor Yorn

Ramon wants to get back to Professor Yorn’s classroom to get some help. However, he is being menaced by shadow beasts in the hallways and has to be cunning and fast to make it there safely. Despite safely making it to the classroom, Ramon finds that Professor Yorn won’t help him because he is too distraught. Some ne’er do well has abducted the teacher’s beloved dog!

*Spells used: Escalate, Freeze, Break*  
*Mathematical operations used: - × ÷*

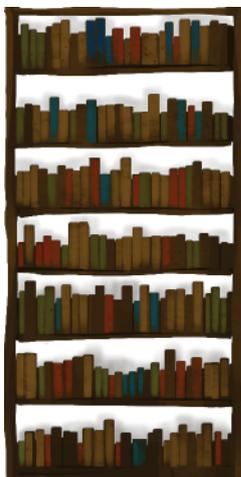


### Level 5 – Headmasters

At the advice of her new friend Iona starts to go even deeper into the catacombs, to the older part. There she discovers the chamber of the Headmasters, who have some information for her. They speak of a portal to the shadow realms, located deep beneath the academy. Someone has been messing about with it, but since they can’t move, there’s not much they can do about it. Iona will have to find the portal and close it to save the academy and her fellow students. Sadly, there is a huge chasm between here and there so she needs a new spell and asks Ramon to find it in the library.



*Spells used: Light, Escalate, Freeze, Break, Stag Leap*  
*Mathematical operations used: + - × ÷*



### Level 6 – The Library

Ramon is off to the library to try to find more information to help Iona escape her desperate situation. There the librarian will help him discover the Frozen Path spell plus how to use green crystals. This level introduces the spell Frozen Path which is cast by multiplying the red and green crystals and then subtracting the result from the yellow crystal.

*Spells used: Escalate, Freeze*  
*Mathematical operations used: - ×*





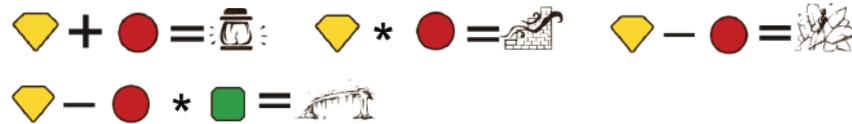
### Level 7 – Lord of the Shadows

Crossing the chasm with the Frozen Path spell, Iona ventures deeper into the catacombs. While cloaked in the shadows she witnesses Miss Mileena talking to the Lord of the Shadow Beasts. Mileena is using the Fire spell to light candles, which allows Iona to learn that spell. Mileena tells the Lord of the Shadow Beasts that she has Professor Yorn’s dog in her house, locked up with magic traps. She also reveals that she has taken the headmaster deep into the catacombs.

This level introduces the Fire spell which is cast by multiplying the red and green crystals and then adding the yellow crystal.

*Spells used: Light, Escalate, Freeze, Frozen Path*

*Mathematical operations used: + - ×*



### Level 8 – Crossing the Enchanted Forest

Ramon must make his way through the Enchanted Forest to get to Miss Mileena’s house. The forest, however, is crawling with shadow beasts. Good thing he can now use the Fire spell.



*Spells used: Fire, Freeze, Stag Leap*

*Mathematical operations used: + ×*

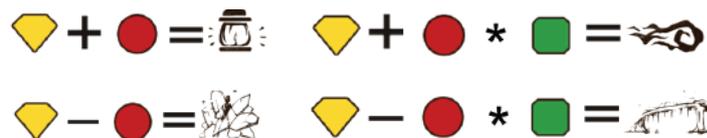


### Level 9 – The Stranded Headmaster

Iona continues her delving through the catacombs, searching for the portal when she comes upon the headmaster, who is stranded on a pillar. Using the Frozen Path spell she is able to reach him. He isn’t able to use any magic since he doesn’t have any crystals. The headmaster tells her about the portal, Mileena’s traps, and how to use the Detect Magic spell. This level introduces the Detect Magic spell which is cast by multiplying the yellow and red crystals and then subtracting the green crystal.

*Spells used: Light, Fire, Freeze, Frozen Path*

*Mathematical operations used: + - ×*



### Level 10 – Entering Mileena’s House

Ramon arrives at Miss Mileena’s house, enters it and has to evade her traps. He finds her plans to open the portal wide and rescues Mr. Fluffles, Professor Yorn’s dog.

He also discovers notes that show how to get to the portal through an old well shaft, plus the instructions for the spell Levitate. This level introduces the Levitate spell which works by adding the green and red crystals and then subtracting the yellow crystal.



Spells used: Detect Magic, Freeze, Fire, Break  
Mathematical operations used: + - × ÷

$$\text{Yellow Diamond} * \text{Red Circle} - \text{Green Square} = \text{Eye} \quad \text{Yellow Diamond} - \text{Red Circle} = \text{Spider} \quad \text{Yellow Diamond} + \text{Red Circle} * \text{Green Square} = \text{Fire}$$



### Level 11 - Finding the Portal

Iona finally discovers the hidden portal in the catacombs. Of course nothing comes easily, so she has to battle some monsters first. This level introduces the Explode spell which is triggered by dividing the yellow crystal by the red crystal and the adding the green crystal.

Spells used: Light, Fire, Freeze, Frozen Path, Break, Stag Leap, Levitate  
Mathematical operations used: + - × ÷

$$\text{Yellow Diamond} + \text{Red Circle} = \text{Light} \quad \text{Yellow Diamond} + \text{Red Circle} * \text{Green Square} = \text{Fire} \quad \text{Yellow Diamond} \div \text{Red Circle} + \text{Green Square} = \text{Explode} \\ \text{Yellow Diamond} - \text{Red Circle} = \text{Spider}$$

### Level 12 – Fight in the Forest

Ramon asks Mr. Fluffles to tell Professor Yorn about the route to the portal that the notes in Miss Mileena’s house described. The young student then makes his way back through the Enchanted Forest to the old well shaft.



Spells used: Fire, Explode, Freeze, Levitate  
Mathematical operations used: + - × ÷

$$\text{Green Square} + \text{Red Circle} - \text{Yellow Diamond} = \text{Light} \quad \text{Yellow Diamond} \div \text{Red Circle} + \text{Green Square} = \text{Explode} \quad \text{Yellow Diamond} - \text{Red Circle} = \text{Spider} \\ \text{Yellow Diamond} + \text{Red Circle} * \text{Green Square} = \text{Fire}$$

### Level 13 – Fight for the Portal

All the teachers arrive at the portal and are going to use their combined magic to close it. However they are interrupted by an attack of shadow beasts, so Ramon and Iona must hold back the monsters so the teachers can finish their spells to close the portal.

Spells used: Light, Fire, Explode, Freeze  
Mathematical operations used: + - × ÷

$$\text{Yellow Diamond} + \text{Red Circle} = \text{Light} \quad \text{Yellow Diamond} + \text{Red Circle} * \text{Green Square} = \text{Fire} \quad \text{Yellow Diamond} \div \text{Red Circle} + \text{Green Square} = \text{Explode} \\ \text{Yellow Diamond} - \text{Red Circle} = \text{Spider}$$



# Game Manual



In this section:

- 1 - Starting the game and basic controls
  - how to control the character (and where on the screen)?
  - how to make spells (and where on the screen)?
  - how to draw numbers
- 2 - Interface
  - What do you see on the screen?
  - Where to touch
- 3 - Game mechanics
  - Victory conditions.
  - How do you complete the levels?
- 4 - Spells
  - what are they?
  - How the spells work?
  - Choosing spells.
  - Spell table.
- 5 - Enemies and traps
  - How they work?
  - Adjusting your spells
- 6 - Interactive Objects
  - What are they?
  - How they work?
- 7 - Non Player Characters
  - What are they?
  - Where can you find them?
- 8 - Installation Guide

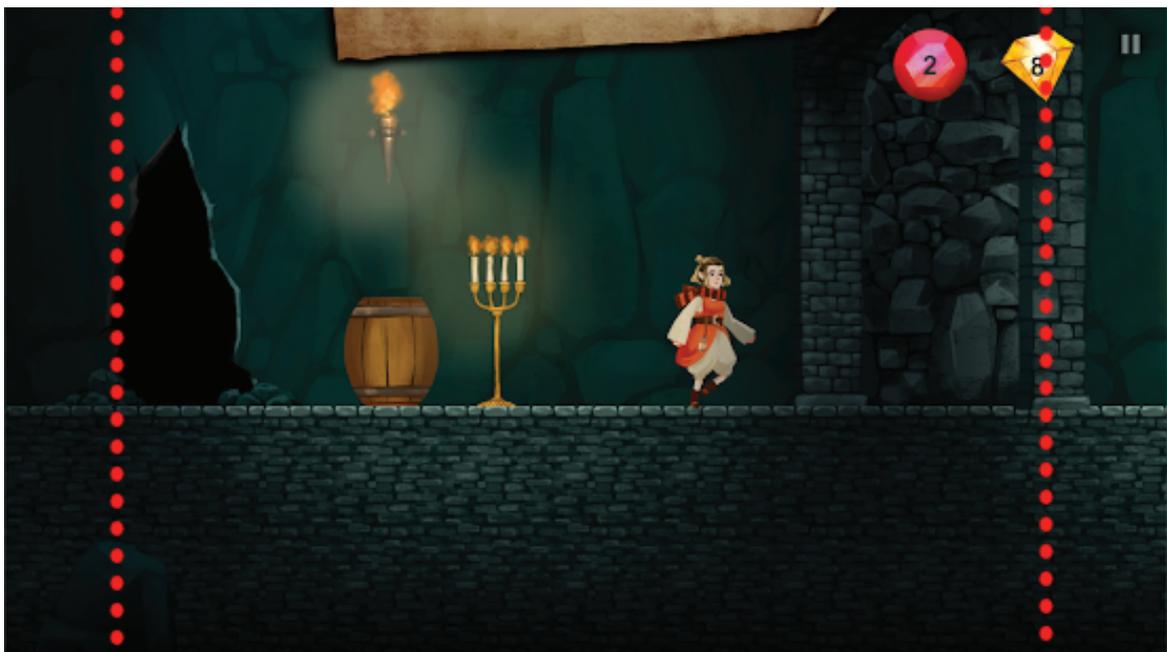
## 1 - Starting the game and Controls

- how to control the character (and where on the screen)
- how to make spells (and where on the screen)
- how to draw numbers

When the game launch you have access to the initial menu that is pretty much self explanatory. Just tap on play and you will start a small tutorial.



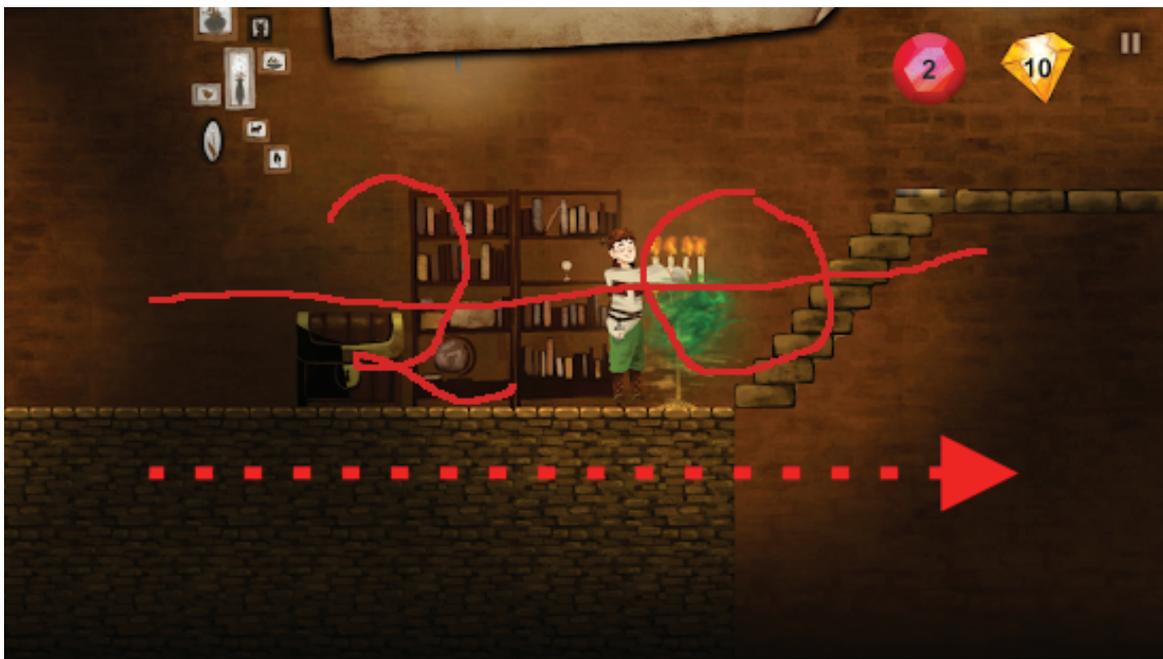
The character is controlled in two directions (left and right) by touching the right and left edge of the screen. However, if you do abuse that the character will get dizzy and fall on the ground. If you think your character is going to fall off just tap the opposite side to turn them around.



You should touch in left and right edges of the screen to move the character left and right



You make spells by drawing the numbers that are a result of particular math calculation. When you multiply the number on the red crystal by the number on the yellow crystal you will be doing the illusion spell in which the stairs become visible so you can use them. After you draw the number, the game will give you visual feedback of the number you just made but you need to swipe a line over it for the spell to take effect.



In this case you will draw the number 20 and draw a line over it in the direction of the arrow. The number should be in the center of the screen as you can see in the figure. You necessarily need to pay attention to the position of your character because you will have to control him left and right for him not to fall in the pit if you made the wrong spell or write the wrong number

If you correctly cast a stair the character will go up as he pass by it, so you do not need to do an extra action. However you must take into the account the number that you are drawing and the distance from the challenge to make sure you have the time.

As already point out, If you do not do the correct number, nothing happens, and you may fall on the abyss if you do not turn back.

Tip: It can be hard sometimes to draw the numbers. Remember - each number must be drawn in ONE stroke, so practice how to draw hard numbers like "4" (left, up, down....).

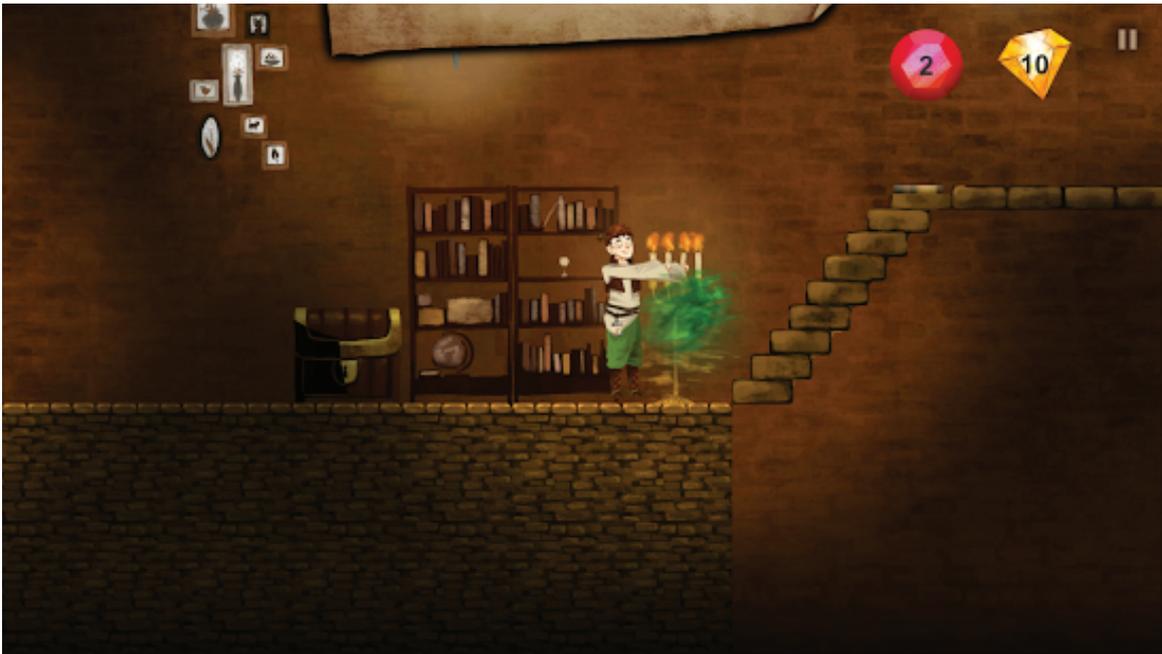
Another tip! Once you have drawn your spell, you must cast it by swiping your finger across the middle as shown in the line going through the 20 above.

## 2 - Interface

- What do you see on the screen?
- Where to touch.



When playing the game you should pay attention to the crystals that are available on the top right section of the screen and the numbers written on it. The math combination between these numbers will allow you to make the necessary spells to get through out the game.



You also need to be aware of the position of the character and where the challenges are placed, but you will learn to do this by playing the game. When you do the wrong number you will have the opportunity to cancel pressing a little cross on the bottom left part of the screen.



Also, to help you, you will be able to touch on the top and see the recommended spell, for example, in the next figure, you will see an hint showing the spell for casting light in lamps.

### 3 - Game mechanics

- Victory conditions.
- How do you complete the levels?



In the game you fail when you miss a challenge that kills the character. That will happen by falling, touching spikes or similar and by being in contact with a monster. Failing a spell will not kill you instantly, most of the time you can run back but will put you in potential bad situation, however you can just make the spell again if you are quick enough. A successful spell will allow to overcome the obstacle.

When you cast a spell it will be effective to its specific kind of challenge for some seconds. After the time run out, you need to cast the spell again. You need to think in advance, so the spell must be ready at the time the challenge is in front of the character.



The level will be finished when you encounter the exit door. You don't need to finish all the challenges as long as you can get to the exit that will lead you to the next level.

## 4 - Spells

- what are they?
- How the spells work?
- Choosing spells.
- Spell table.



The spells are the different calculations that you must do. A particular calculation, like adding the numbers of two crystals will allow you to do the spell as long as you draw the correct result. You draw the result on the touchscreen and a timer will start during which the spell can work. You have to be in reach of the specific challenge for that spell for it to produce its effect.

You must know what are the spells and what they do. Also, you need to know when to use them and in what kind of situation. The game will give you hints about this, so in most situation their use will be very obvious. The game will also have a spellbook that you can use or you can look at spellbook in this handbook.

# Spellbook

(you can print this out)



Nr.	Spell	Effect	Operation (Suggestion)
1.1	Light	- lights area	 + 
1.2	Fire	- lights area - attack monsters	 +  * 
2.1	Illusion	- stairs become solid	 * 
2.2	Detect Magic	- highlights magical traps in area	 *  - 
3.1	Freeze	- monsters stop moving for a little while	 - 
3.2	Frozen Path	- creates a bridge over a chasm or gap	 -  * 
4.1	Break	- splits weak structures (crumbly walls, old doors etc.)	 / 
4.2	Explode	- splits sturdy structures like locks and doors - attack monsters	 /  * 
5.1	Air boost	- a little jump	 + 
5.2	Levitate	- float upwards and sink slowly over time	 +  - 
6.1	Lightning	- powers small apparatuses	 * 
6.2	Electrocute	- powers big apparatuses - attacks monsters	 *  + 
7	Detect Weakness	- shows monster weakness in a bossfight	(  *  ) / 

## 5 - Enemies and traps

- how they work?
- what spells should you use?



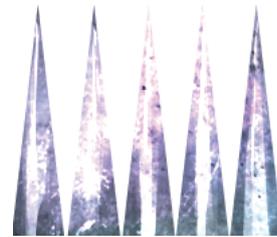
The world of Enchanted Crystals is a dangerous place. You should know your spell so you can overcome the creatures that lurk in the shadows. For that you can use certain spells that will disable your foes or you can simply run and avoid them. Some spells such as freeze can be effective against the many enemies that you will see in the game, so pay attention and use your spells wisely.

Some enemies just stay on a certain area but other will pursue as long as you stay in range. When you get too close to an enemy your character will enter bullet time (slow down) and you have a certain time to make a spell or flee.

## 6 - Interactive Objects

- What are they?
- How they work?

Some perils are stationary. You must avoid to touch certain objects in the game. They will be very easy to recognize, so don't worry. Sometime you may need to use a specific spell that will allow you to avoid these dangers and progress in the level.



Some objects also can be interacted but are not dangerous, like many lamps where you can use the light spell. However, you should pay attention to your surroundings to spot interactions opportunities.



## 7 - Non Player Characters

- What are they?
- Where can you find them?

The world of Enchanted Crystals is full of interesting encounters. You will meet strange and interesting characters that will help you (or not) in your quest. This character can be found inside the game world and will engage you, sometime teaching you spells and giving clues about what you have to do next. The story of the game will be told in this interactions, so take notice of every word that you hear.



## 8 - installation guide

Android version:



You can look for the game in the Google Play store. You will see the logo on your android device.



Just click on it and write Enchanted Crystals in the search bar. Then, we expect that the game will show up.

You click on it and you will see an option to install it. Press it, wait for the installation. You can start from the game installation or you can go to the phone initial screen and click the enchanted crystals icon.



Remember that you need to have enough space on the phone to install the game.

Apple's iOS version has a similar installation, the store and interface have some differences, but it's basically the same process. Instead of Play store, you will have the App Store, the rest it's almost the same.



# Lesson Plans



Here you will find some suggestion how to use the game in your school. We know teacher are very short on time, so we already did some lesson plans and guidelines to help you start. Nevertheless, we are expecting that you will use your teacher's natural capability of adaptation to challenges to come up with better ideas.



Class:	school year: Students from 3rd to 6th grade who need to build fluency with basic math operations.
Date:	Lessons: 10 sessions 30 minutes each
Curriculum: 4th - 6th grade curriculum in after school activities	
<b>Summary:</b> Use of a video game to train the basic math operation	
<p><b>Strategy:</b></p> <ol style="list-style-type: none"> <li>1) The students of the afterschool activities are split into two groups and take a test on basic operations.</li> <li>2) The teacher assigns one group of students to use the app while the other group continues with standard lessons.</li> <li>3) A small familiarization session is performed to the students of the first group on the first day. Then they proceed by playing the app for 30' minutes per day for the following 3 days.</li> <li>4) On the 5th day the students of both teams take a 30 minutes test.</li> <li>5) On the next days the groups change place and the above steps are repeated.</li> <li>6) On the final day students take the final test.</li> </ol>	
<p><b>Main goal:</b> Improve math skills at the level of the basic operations and on the same time to test the LEVEL app in school environment.</p>	
<p><b>Specific goals:</b></p> <ul style="list-style-type: none"> <li>- Identify the students initial level of performance before the game</li> <li>- Identify what are the main difficulties the students are having in the game</li> <li>- Evaluate the groups progression in the four math operations</li> <li>- Identify persistent problems that the game is not solving</li> <li>- Verify if the students transfer their new skills to a different medium</li> </ul>	
<p>Possible evaluation:</p> <ul style="list-style-type: none"> <li>- Observe how students from different groups are responding to the teachings.</li> <li>- Make frequent notes about the students math difficulties so you can compare with the students notes.</li> <li>- Create transfer activities and evaluate if the students show similar performance at least in near transfer scenarios.</li> <li>- Use the results of the test to determine which group was better motivated and finally improved the fluency on basic operations.</li> <li>- Interview the students that still perform poor on math after those sessions and try to figure out the reasons.</li> </ul>	<p>Extras:</p> <ul style="list-style-type: none"> <li>- The Teacher owes to test the game before the students so he can identify the type of challenge and understand the mechanics.</li> <li>- You must take notice what kind of devices the students have access and if they need help installing the game. This better be done on the familiarisation day.</li> <li>- After processing the tests (initial, midtestet, final test) fully analyse the outcomes on each group of students.</li> <li>- In case some students still perform poor on basic operations ask them to continue using the app at home.</li> </ul>



Class:	school year: 3-4th grade or particular Special Needs class.
Date:	Lessons: 2
Curriculum: 3-4th grade curriculum or Special Needs adapted curriculum	
<b>Summary:</b> Use of a video game to train the basic math operation	
<b>Strategy:</b> <ol style="list-style-type: none"> <li>1) Test the students initial skills with math exercises that include math operations similar to the game</li> <li>2) Try out the game for the student understand the game mechanics</li> <li>3) Two 30 minutes game sessions in the school and a week playing the game at home as homework</li> <li>4) Send the game as homework during a week where they should play everyday</li> <li>5) Make small text after the game session and after a week</li> <li>6) Use a transfer medium (we suggest the <a href="#">card game</a> in this handbook)</li> </ol>	
<b>Main goal:</b> Improve math skills at the level of the basic operations	
<b>Specific goals:</b> <ul style="list-style-type: none"> <li>- Identify the students initial level of performance before the game</li> <li>- Identify what are the main math difficulties the students are having in the game</li> <li>- Make sure the students notice what are their math difficulties</li> <li>- Evaluate the students progression in the four math operations</li> <li>- Identify persistent problems that the game is not solving</li> <li>- Address non solved problems with extra activities</li> <li>- Verify if the students transfer their new skills to a different medium</li> </ul>	
Possible evaluation: <ul style="list-style-type: none"> <li>- Create a small post experience text with similar operation after the game session and after a week.</li> <li>- Observe students failures and made them register them. Repeat this process and verify what they are improving and what they still can't solve.</li> <li>- Make frequent notes about the students math difficulties so you can compare with the students notes.</li> <li>- Play the card game (instructions) Create transfer activities and evaluate if the students show similar performance at least in near transfer scenarios.</li> </ul>	Extras: <ul style="list-style-type: none"> <li>- Test the game yourself so you can identify the type of challenge and understand the mechanics.</li> <li>- After the session at school you should send the game as homework and text the improvements after one week.</li> <li>- You must take notice what kind of devices the students have access and if they need help installing the game.</li> <li>- We will suggest one session on the first week and other in the second week.</li> <li>- We suggest the use of the card game to help you teaching the students which also work as a near transfer medium.</li> <li>- Younger kids and kids with disabilities may need extra time to access the game mechanics and controls of the game.</li> <li>- Read the <a href="#">guidelines</a></li> <li>- Involve the parents</li> </ul>



# The Card Game



## Heroes

Iona: Player 1

boy: Player 2



## Competitive play

The player who has more correct answers in the time frame wins.

## Chess Clock

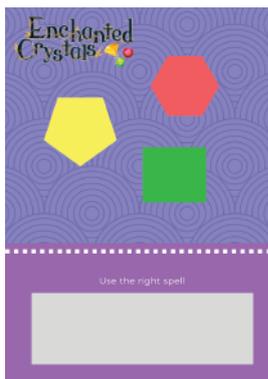
We suggest 20 second per card (if the level has 6 challenges, it will be 2 min per player), but you can set a different time limit.

## Cards

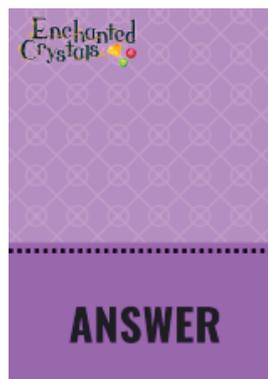
In on side there is a challenge in the other the result. The game brings some preset cards and blank defaults to create more.

- Monster cards
- Obstacle card
- Cards can have different difficulties, in that case they will be of different color and both player should have the same amount placed in the map.

The result would be on side two (a number or more in the case of more the one answer).



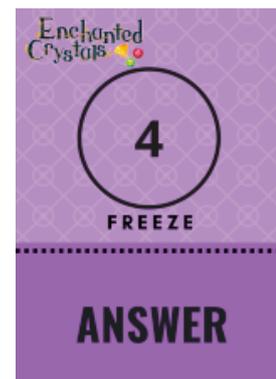
Challenge (blank)



Answer (blank)

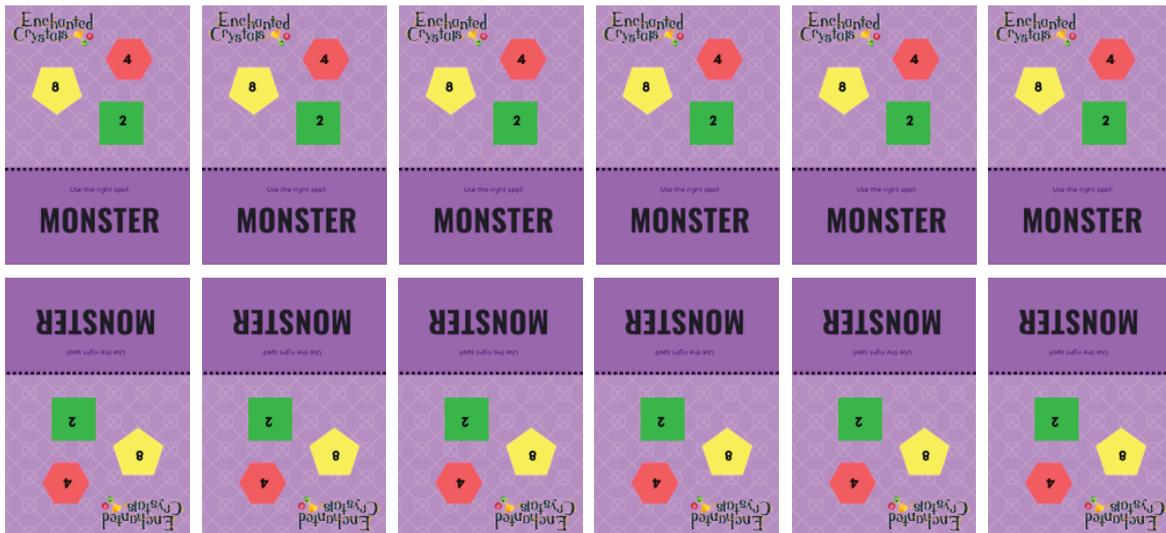


Challenge example

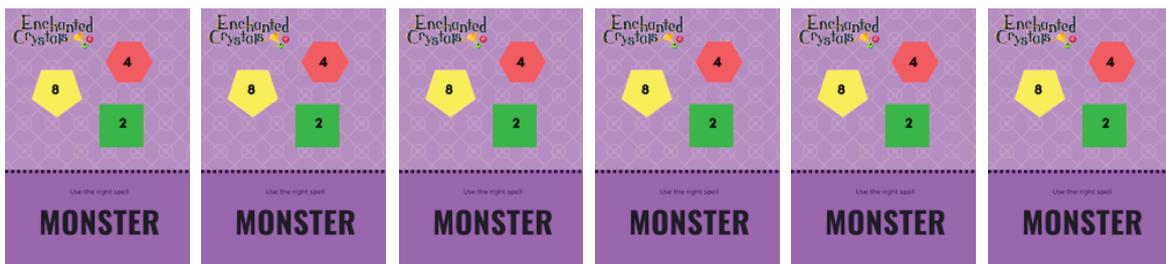


Answer example

**Map** with to paths of spaces for cards and a guide for doing levels, or just place the cards one after the other.



1. Put the card in the designated spaces, showing the challenge. there should be two different lines of cards, one for each player.
2. Put the players facing each other (the cards must face the players).
3. The player(2), who starts in second, presses the clock.
4. The other player(1) tries to guess and turn the card (**saying the spell and number**).
5. If he (1) was right, he would let the card stay and press the clock.
6. The player(1) should put the car out, if he loses, and press the clock.
7. The other player(2) plays his turn and press the clock (4 to 6).
8. Back to step 4.
9. At the end the player with more cards on the table wins.
10. The player of goes out of time stops playing until the other uses all of it's time.
11. In case of draw, both player should pile the cards and pick cards alternately and try to respond to the challenge in 10 seconds. The winner is the one that responds correct when the other fails. If both are right or fail, the game continues.



Cooperative play: On map and one path. The two player should respond correctly to all the card challenges in the time frame to have a full win. In the other cases they will get a such as 4 out 6, for example.

**Card building:** use the card default layout to build your cards. Be aware of spell where division must be used, you need a integer number as result.

Note: numbers [generators](#) apps can help on building new cards.

# Guidelines for the use of the game in 4th grade / Special Education



These are some guideline for the use of the game in special education, but could be also adapted for regular classroom with minimal changes. The main difference is that a regular classroom may not need to address all the aspect that are highlighted here and you will get a more homogeneous group, because in special needs you will get more extreme difficulties.

## 1 - Students characteristics

First the teacher must evaluate what kind of difficulties/disabilities he has on her of his classroom and make a class trial with the game to see how the students handle the interface. You need to notice if some students are having problem with the control of the game in the devices that are being used. Other type of problem you want to address will be if the complexity and speed of the calculations needed to be adjusted. The game has three levels of speed and difficulty.

## 2- Small or bigger screens

The size of the mobile device may or may not help the students but that could facilitate control and vision of the game in some situations. The use of chromecast or other similar technology can help you put the video em sound on the big screen, also can be a way to involve the class, especially for students who have difficulty in controlling the game.

## 3 - Control and Interface learning

In the beginning the efforts should be direct to the interface, the student needs to recognize the important elements on the screen, what he need to pay attention to play the game. Also, he need to know where to draw the number and how to go left and right. This could take some time and will depend on the student, but after 5 minutes most of the students will be familiar with the controls and the interface.

## 4 - Knowing the numbers

The game needs that the student can identify the numbers. In a regular class you won't have this problem, but in special needs, having a prior preparation would be a must. You may have to train your kids on number recognition in more extreme cases or with very small kids. In this situation practicing number drawing would be a benefit by itself. Having a list of all the numbers next to the game may help in the beginning.

## 5 - Drawing the numbers

In most regular classes this will not be a problem, but you may want to train your student in numbers drawing. Pay special attention how the numbers are drawn in the game so the kids don't become frustrated. The game is flexible in number drawing but some numbers like the 4 and the 7 need to be drawn in a particular manner. This is explained in the tutorial when you start the game for the first time. The role of the teacher is to reduce some initial frustration that may arise as a result of the kids are used to writing the number in a different manner. We suggest that you explain to them that this happens because a computer is not as smart as the human brain in pattern recognition.

## 6 - Knowing how to make math operations

The kid should not enter the game without knowing to do some basic math operation. It will be ideal that they had some prior preparation before using the game. Having a basic operations table available during the gameplay could be useful. The game can't really teach math operation but will allow the kid to train on doing that, having a source of information to help them will create a smoother experience in the beginning, but the operations table will not help them much on the harder levels. That will depend on the strategy and aims of the teacher and also on the kind of students that he has.

## 7 - Learning the timing

Some levels are harder because you will have just an amount of time to do the operation. With experience, some kids will get better and faster. Nevertheless, it could happen that some kids are not fast enough. The game allows for a slower speed, so that can be an option. However, if the problem persists, a possible solution, at least in the beginning, would be putting a faster student drawing and the other saying the numbers. The student will be missing on the drawing aspect but will still be training math operations. Collaborative play in general will enhance the game experience, even with students who are more at ease with the game.

## 8 - Enchanted Crystals - The Card Game (representation of the game)

The idea of using a physical version of the game is specially directed to kids that can't play the game or are having major difficulties. It allows to prepare your students for the game and can be an easier way to explain the game to them in the beginning. The slower pace of the physical game may offer more teaching opportunities and can also work as a near transfer medium of the students' skills. But can be seen also as a way to introduce novelty in the activity and a different way to play this game, because in the end it's all about practicing math operations.

## 9 - Dealing with frustration: errors and drawing badly

The worst thing that can happen is for the kid to get frustrated while playing the game. A little bit of frustration may not be a problem, but high levels of frustration won't be good, especially if the kids are being stuck in a part of the game, that certainly won't help. The teacher need to pay attention to see if some kids are struggling with the game which can be a result of many reasons. As we point out before, It could happen that the kid has drawn the number in a way that the game won't recognise, he may not be very good at math operations in general or, for example, can just be some kind of technical problem. You must be aware of this and try to detect the source of the problem. To identify the problem watch the kid play. In some extreme cases , stop the game and try to solve the problem, resume only when you have a way to deal with the situation.

## 10 - Collaboration opportunities

We already suggested some situation where collaboration could be useful. But you could start with a collaborative strategy. Putting two kid in one device or projecting the game-play of one of students, by using chromecast for example, would create a more social experience where all the students could participate and you would have more chances to intervene.

## 11 - Evaluation

Having math quizzes between the sessions or using the physical representation of the game would allow for you to have an easier time and will allow you to evaluate the students performance in a different set of conditions. Ideally this type of evaluation could occur before and after the gameplay. You could also create other training and transfer scenarios where the student need to use math operation skills. Direct observation of the gameplay and noticing the students progress in the game can also be a good way to have a general idea of the student math capabilities. If the students completed the game in a small amount of time, in the at the fastest speed and in the harder level, that probably will mean something.

## 12 - Beyond the class.

The student could be incentivized to play the game at home as homework. Create worksheets to test their skill after asking them to play at home. Involve their parents and family on playing the game with the student. The point is that practicing math operations will make the students better at it and that can help them to be good at math in general, and if they are good they will like it more.

## Other Games you may like

- Dragonbox

# Project and team info



## About the Project

There is no doubt that game-based learning holds endless opportunities in education and that we are still far from taking full advantage of it. The intention of creating a game like Enchanted Crystals was to build a showcase in which we integrated learning content from a school curriculum into a mobile game that is highly motivating. We wanted to create a game which lets learners practice their math skills and have fun doing it. This also gave us the opportunity to study the quality of learning achieved through the game, thus contributing to the further development and advancement of mobile learning and game-based learning in general. Additionally by focusing on making a mobile game we have created something that young people can play at home, on their own devices.

## About the Project Partners



### **Ingenious Knowledge**

Ingenious Knowledge is a small company founded in 2010 in Cologne. The company is heavily involved in education research in cooperation with universities world-wide and develops a lot of software tools. One of the main strengths is creating next generation serious games with the aim of making games that are good enough to compete with commercial entertainment games. Ingenious Knowledge has the expertise to develop cutting edge solutions and is eager to spread better education approaches around the world.

**Platon Schools** (Kindergarten – Primary – Secondary – Lifelong Learning Centre) is a modern educational institution with 650 learners and 120 staff. Through the use of the most up-to-date facilities, a diverse curriculum, experienced and skilled teaching staff and, most importantly, through consistency on principles and respect towards pupils and parents, our school has been striving during the last ten years for the accomplished education of our pupils. Platon's staff design and develop learning and teaching material in formal and informal methods and has trained and applied many innovative activities in all grades.

### **Escola Secundária de Lagoa (ESL)**

Escola Secundária de Lagoa is located at the City of Lagoa, in São Miguel Island, Azores. It's a School with a great diversity of students from very different economic backgrounds. We strive to give all students the best education possible, for that we are



open to creative strategies and resources. In ESL we have students from the 7th to the 12th grade and also special curriculum and special needs. Inclusivity is one of our great goals and we try to keep up with the latests practice and technologies.

### **GCU**

Glasgow Caledonian University's commitment to the Common Good is realised in applied research which addresses three major societal challenges, enabling communities in the UK and internationally to build Inclusive Societies and live Healthy Lives in Sustainable Environments.

GCU's Applied Games team has expertise in the design and development of digital video games. Our team members have worked in various industry roles and on some of the world's largest and most innovative Applied Games projects tackling the world's biggest problems including antibiotic resistance education, global climate change and games for mental and physical health.

Additional Thanks to:

- Richy Welsh and Gordon Kerr for services in dialogue audio engineering

Actors:

- Ramon, Yorn, Deadmaster 1 – Gordon Kerr
- Iona – Caitlin-hope Elizabeth Turner
- Wadsworth, the librarian, Deadmaster 2 & 3 – Richy Walsh

# Frequently Asked Questions



## Technical

- I am having problems while installing the game?
- I drew the right number and nothing happened?
- Can my phone run the game?

## Menus and Interface

- Why do you make me write numbers this weird way?
- How do I move the character?
- Can I skip the movies?
- I am being presented with the option to choose between two spells.

## Gameplay

- What can I do if my pupils find the game too hard?
- How can I cast a spell?
- What happens when I fail to cast a spell?
- I did the correct spell but nothing happened?
- How do I win?
- How is my progress saved between sessions?
- Why my character is always falling?
- Can I reduce/increase difficulty and speed?
- How to deal with monsters?

## Educational

- What operations are included in the game?
- How can I use the game in the school?
- How can I adequate this game for different kids?
- I am not a student, is this game for me?
- Was this game tested with students?

## Other

- What age group is this game for?
- We don't have tablets in my school?
- I have found a bug.
- Was this game tested in schools?
- Tablets of smartphones?

## Technical

### I am having problems while installing the game?



- In the Android version you can go to the Play Store and install the game, on IOS you will be facing a similar situation.

- Remember that you need to have enough space on the phone to install the game.

- Some application that interfere with the touch screen may affect your experience. So if you have any special accessibility software and experience problems, experiment with turning it off to play the game.

- You can install the game manually on Android using an APK file, for that you need to allow unknown sources on your phone. You can find the APK file on our site.

- You will see an “install unknown apps” warning, hit Settings and toggle “Allow from this source” and head back to the installer.

### I drew the right number and nothing happened

You must do a line over the number from left to right. It should work every time, when you do a number the game gives you a feedback of the number that you just drawn, if you did that right and made a line over it should register. Many people try to draw their numbers too fast. The game makes the

Other solution is to close the app and open it again. If the problem persist, try other device, maybe you have some active app that is affecting the touchscreen, for example. You can try to reach us by email with the details of your problem, the model of your phone and its operative system.

### Can my phone run the game?

For Android phones (like Samsung or Huawei or Lenovo) the game has been tested and in most cases it can run on phones made in 2013 and newer. It may work on older phones but it could be slow. Try it and see!

For iOS the game it has been tested and runs fine on iPhones 5 and newer without any problems. Again, it might work on older phones but it could be slow.

## Menu and Interface

### **Why do you make me write numbers this weird way?**

There are different ways for drawing a 4 or a 7, for example. Each one of us has our own personal calligraphy but we can recognize most numbers that other people had drawn. We tried to factor that into the interface of the game, but interfaces have their limitations, so we tried to compromise between variety and the best way to do it. We are sorry that if sometimes it's not your usual way, but after a minute it will become second nature.

### **How do I move the character**

Just tap the left and right edges of the screen to move left and right. Be careful because when you write a spell the character keeps running.

### **Can I skip the movies?**

Just tap on the movie and you will skip it. However, you will be missing a great story.

### **I am being presented with the option to choose between two spells.**

Sometimes two different math operations can have the same result, such as  $2 \times 2$  and  $2 + 2$ . Those two math operations are associated with different spells. The game will let the player choose which spell he wants.

## Gameplay

### **What can I do if my pupils find the game too hard?**

The first thing you can do is to reduce the speed and difficulty of the game. If that does not solve your problem in the options screen, the second thing you should do is to watch them play and identify why they find it difficult. Make sure that they did understand the interface, then you can check if the pupils are drawing the numbers correctly. Maybe they are doing it right but not the way the game recognizes and that's the game's fault. We ask for your patience and ask the kids to write the numbers in a manner that the game can recognize. Difficulty can come also from the type of challenges that the kids are facing. Try to understand which are their exact difficulties. Do some training out of the game and then return to the game and see if the results improve. Remember, the game does not teach math, it trains the player on doing math operations. You will find more detailed help on chapter 6.

### **How can I cast a spell**

When you write a number and check it with a line over it you are doing a spell. Spells are the results of math operations. If you write a number that relates to a valid and correct math operation between two crystals you are doing a specific spell. The spell does something in the game such as breaking a column. If two crystal combinations with different math operations give you the same number you will be able to choose between the spell that are shown on the screen, however most of the time a certain number is related with only one spell that activates near the challenge. If the spell is not related to the challenge nothing will happen. A small timer is shown and during the time the spell has a possibility of affecting the world of Enchanted Crystals.

**What happens when I fail to cast a spell?**

If you did no spell, nothing happens, however, if you did the wrong spell it will be triggered but with no effect, unless you do encounter a specific kind of target while the counter is not finished. Nonetheless, you can do another spell without waiting for the counter to finish.

**I did the correct spell but nothing happened?**

You need to be at a certain distance for the spell to work. You can do it before the target, but it will only work at a certain distance from the target.

**How do I win?**

At the end of each level you will find a door. Just go through there to the next level. However for that to happen you must overcome the challenges. But even if you skip a challenge you will still complete the level.

**How is my progress saved between sessions?**

The progress is saved automatically when you finish a level. From now on you will access that the next level and all the levels that you completed until now. You may want to repeat some levels to get better scores or just train some kind of math operations.

**Why my character is always falling?**

If you touch left and right too many times and fast your character gets dizzy and fall. He is only human after all.

**Can I reduce/increase the difficulty and speed?**

Yes, you have three levels of difficulty which change the size of the numbers, and three levels of speed. Press options/settings on the initial menu to access these configurations.

**How to deal with monsters?**

You can run and avoid them by going in a different route or you can use a spell such as the freeze spell that will immobilize them for a short period of time, which you can use to pass through them, for example.

## Educational

**What math operations are included in the game?**

The game include the 4 basic operations. They are included in the different spells. The player will be doing all of the math operations in the context of the spells. With different levels of difficulty the player will face more complex operations, which means bigger numbers, but the mechanics of the game will stay the same.

**How can I use the game in the school?**

The main point of this game is to practice math operations. In this book we make some suggestions how you can use it in the classroom and as homework. We also give you a manual to construct a card game version of the game to use in the classroom as a game companion. However, be creative knowing that the strength of the game is the fact that the student will be practicing multiple combinations of math operations

**How can I adequate this game for different kids?**

The game allows you to change the size of the numbers and speed of the game. You can use the knowledge that you have of your class to best adequate the game, but make some tests in the beginning, you may not want for the game to be difficult, however, if it's too easy the students won't like it either.

**I am not a student. It's this game for me?**

The short answer is yes. Math operations are useful for everyone. An exercised brain can age better.

## Other

**What age group is this game for?**

Anyone can play this game, but the game is firstly directly for 9-12 years old kids. However, younger kids can still play it on the easier levels and older ones can practice it the harder levels. In fact anyone can practice with this game and become better at the basic math operations. Also, you can use this game for special needs classes where the age can vary, the main point is that math is good for you. In chapter one you will find a deeper explanation for the use of this game.

**We don't have tablets in our school**

If you don't have mobile devices in your school you can ask if the kids have them at home and can bring their devices to the school. Notice that this may require authorizations from the parents and the school. Other solution is to download the APK file on our site and run it in a normal computer with an android emulator. Also, the students may not be able to bring devices to school but the possibility to play the game at home can still exist. In this case, you can go the homework route favor math training at home

**I have found a bug.**

Feel free to email us. We are always trying to improve our game.

**Was this game tested in schools?**

Yes, this game was tested with the principal age group that it's target for, however, was also tested by adults who recognized that they could do better in math operations if they practice more.

**Tablets of smartphones?**

You must take into account the size of the hands that are using the game. A very big tablet may need to rest in a table, for example, if the player is small kid.