

# Mathmind – Project Report

*By Rickard Remelin  
Game Science Program  
Blekinge School of Technology*

## Abstract

Math students today in the Internet age learn math by reading books and writing on paper. Bits and pieces of information can be found on the web and online courses is available commercially, but there is no single free source web page for studying math. This project is aiming to address this problem by designing a free homepage that will help sustain and evolve itself at a very low cost.

The main idea of making a great webpage for math was to focus on how to get rid of motivation killers instead of trying to find motivating things in math. Lots of motivational help were also added once the main problems had been dealt with.

Even though the idea of the project is very simple, demonstrating it through prototyping was hard due to the lack of knowledge in creating a database in a webpage environment and the lack of knowledge of how to structure math. It was learned though what team actually would be needed to manage to develop the proposed product *Mathmind*.

The team needs to have:

- *Experienced webpage database programmers.*
- *Mathematician's who knows math structures.*
- *A game designer.*

Making the page would take a lot of time to complete (a year or two) but other than that, no extra funding other than the employment pay would be needed.

## Introduction

I've always thought math to be quite boring. The strange thing is that it does not compute with what I actually like to do. I love playing computer games. I love to solve puzzles, figure out problems, structure things and become a master at what I do. Doing math is doing all of this, but why have I not been fond of doing Math?

## Aim

The goal was to find a way to make math much more fun and effective to learn. Similarities between Math and Computer games are vast and thus the aim was to build the structure of a learning center based on computer game design.

## Method

The main points of what is needed to be done:

- *Find out what makes math both boring and fun.*
- *Find out similarities between games and math.*
- *Structure a system based on what is needed on the page.*
- *Create a prototype based on the system.*

I had never done anything similar and I did not know what what kind of skills, knowledge or software is needed to create the page as the structure of the page is not already set. I wanted to search for a suitable system to develop the page in once I knew what I need to do to demonstrate the functionality of the page.

## Results

*The key to learning = Motivation.*

As studying Math actually does have a lot of things which makes games fun already, finding ways to motivate learning is not the main issue here. What we really need to address is the motivation killers. You can make a game which is really unique, have fantastic graphics & sound, interesting story, wonderful gameplay, and every single bit of greatness the perfect game could ever have. But if you make one single thing annoying throughout the game, all the efforts of making it fun have gone to waste. So, what kills the motivation of studying math?

### ***Motivation Killers***

#### *Waiting*

Let's say you are doing math exercises. You look for information on how to solve the problems and it takes time to find it. The correct answer in the back of the book is only the result of the calculations and does not show the whole solution which makes it harder to locate where your calculation has gone wrong. The sample exercise in the beginning of the chapter which shows a similar exercise, is not the same and thus take time to figure out what it has to do with your exercise. After a while you notice that solution for the problem you are looking for is not in the book. It is in another earlier book and you do not have that book. You are now stuck.

#### *Getting stuck*

You've gotten stuck and do not see where you can find a solution to the problem. You try to get hold of another mathbook but it does not seem to help you. You try to read and calculate for hours and you do not seem to get anywhere. You try to find friends to help but either they do not know the answer or those that might are not available at the moment. After a couple of days you get hold of a friend that helps you with the answer. When you finally are done with the exercise after days of struggling, all you get is a finished exercise.

#### *No reward*

After all work you have done, all you got was a finished exercise. You did not see anything happen, you did not get any response what so ever. Now your mind starts to ask, "Why am I doing this?".

*No goal*

You may be studying because you need a math grade to get into an education, but you might not be sure if you really want to go that education. Are there any other reason for you to study? Will you have any use for your math knowledge in the work you are going to do? Will you have any other use for your knowledge in your daily life? Is there really any point in studying at all?

So how do Mathmind get rid of these motivation killers? Let's start from the beginning.

### **Getting rid of waiting**

It will be a lot easier to find the information needed in Mathmind due to many different reasons:

- 1. Complete answer for every exercise**

By looking through how an exercise is calculated, it helps you understand how the exercise works. In math books, complete answers are rarely seen. Giving an answer for every exercise does take up a lot of space in a Math book but that kind of space is of no concern in a computer software.

- 2. The possibility to find all related information**

As *Mathmind* entails not only the area you are working on but all other areas below your level, all related information will be there.

- 3. Searchable information**

With a search engine, you do not need to read through a lot of unrelated pages to find what you need.

### **Less getting stuck**

It will be much less chance of getting stuck with the tons of information available, but if it would happen then *Mathmind* will have a large community that will be able to help you.

### **Lots of rewards**

*Mathmind* will have a huge score and achievement system that will boost motivation and give purpose to the studying.

### **Easy to see goals**

You have your own statistics page where you easily can see your progress. You can see in what area the Math you know can be used or how much you know of what is needed to get a certain job. *Mathmind* will have a list of jobs where different areas of Math is needed. You can thereby see how much and what you need to study in order to get the work you want.

There will also be a list of tasks that you can do with your Math skills. These will also be exercises.

### **Earlier problems with math pages**

So why are there no page like *Mathmind* already? Many Math exercises have different ways of calculating the answer. That makes it very hard to do a software which can randomize exercises. Also taking an exercise a step further creates the need to program another exercise system. This makes the programming about as time consuming as writing the exercises. Creating these exercises is either way a lot of work and what we want is a lot of exercises.

*Mathmind* uses a power much more powerful than any super computer. Human computation.

Instead of trying to randomize exercises with a software or having a large team trying to figure out new exercises, *Mathmind* lets its users add content to the page.

### **Community driven**

*Mathmind* is mainly driven by the community. The users help building exercises and teaches each other by adding extra information to the exercises. This will be done by either text, audio or video. Having a community not only gives people a lot of support by helping each other. It also creates a place where you meet new friends who have a common goal and thus making it a lot more fun.

### **Score, Achievements & Statistics**

When we have gotten rid of the motivation killers and made sure that the page is possible to do, it is time to focus on making it fun.

As told earlier, score, achievements and statistics are a great way to keep up motivation. By knowing what you have accomplished, what goals are in front of you, what paths you can take and always getting confirmation that you are on your way forward, you get motivated to continue until you are done. This effect can be seen since gaming first started, where in the beginning almost every game had a score. You either tried to push your own score higher and higher or tried to beat other people's score. As time progressed, games without a score started to emerge as it became complicated and confusing to give a fair/ amount of points from all the tasks you could do in a single game. Some people wanted to play the game safe without doing any mistake while others wanted to finish the level as fast as possible. The achievement system became a new way of putting a score inside a game without it becoming complicated and yet again push the boundaries of how effective the player have been. The new technique was to set many goals instead of only one numbered score. This also made the replay value a lot higher as you could finish the same game in different gaming styles.

When it comes to math we definitely have many ways of gameplay so to speak as we have a vast amount of different exercises. By adding an achievement system into the math studies we actually gain motivation, overview and a goal in one go and this without any expensive graphics or complicated programming. The achievements are after all only sorted variables, given a value.

Examples of achievements can be:

- *For every 1,10,50,200,500,1000 exercises calculated correctly in each area.*
- *Finishing a certain area of Math.*
  - *based on area specific rules such as number of correctly answered exercises.*
- *Title given when handling the math needed for a certain kind of work position.*
  - *includes a list of jobs accessible only with the math known by the student.*
- *Exercise creation*
  - *every exercise created gives points.*
  - *every exercise solved by someone gives points.*
  - *every solution voted as wrong by the community gives minus points.*
- *Number of help videos and explanations rated "Great!" by the community.*

The achievements page holds a lot of information but if one wants to go deeper into a certain area, the statistics page shows all information of what has happened.

Some examples of statistics:

- *Exercises solved*
  - *shown for every specific area*
- *Most solved areas*
  - *time spent in each area.*
- *Highest amount of equations done without any mistake in each area.*
- *Amount of time taken to calculate.*
  - *for every area and exercise*
- *Exercises contributed*
- *Shown overall and for every area*
- *Number of correctly added exercises*

## **Dueling**

Dueling is another way of making the math exercises becoming a game. When you duel you fight other players for titles and achievements. The challenger can only challenge a person which has completed a certain area of Math. By looking at a players statistics you try to find weaknesses and beat them by choosing the areas you think you have the advantage. This makes the players try to see to it that they do not have any weaknesses. A good balance for making players want to duel will be made by simply giving them achievement points.

The fight itself is actually ordinary exercises. So this will also be extremely easy to program and no complicated graphics will be needed.

## **Teamwork**

In the teamwork mode, people will be able to help each other out and do the same exercises together. As calculating is often done together with friends, that should also be possible in *Mathmind*. However for this to be done we need a good interface and that will be a bit trickier to develop.

## **The interface**

To be able to design an interface you need to know it's features. The features in this case depends on what math exercises are being done. In order to figure out how the interface should look, you need to get an overview of as many different exercises as possible. This is very hard if you are not someone who do all kinds of math exercises regularly. For every single exercise there needs to be a feature to make it possible to do it fast and easy. The interface needs to be at least as effective as pen & paper otherwise people will get annoyed by this degradation and go back to using a book even if the other features are much greater. The interface could, if developed badly, be a motivation killer. As math is a huge area which is hard to cover all in one go, the interface needs to be done with reconfiguration in mind. It must be technically easy to enter new features into the interface. It also should not confuse the user when new features gets added. As math is a study done by all kinds of people one needs to take into consideration all different kinds of users.

These can be people who:

- *have disabilities.*
- *want the interface to be easy to understand instead of effective.*
- *want the interface to be effective instead of easy to understand.*

Creating all the different usage areas combined should be aimed for. Having a list of symbols to choose from which one can pick up by mouse can also serve to show it's keyboard shortcut and we have thus both fast and easy use of symbols combined. Options to hide or change the interface would also be recommended.

## How to develop Full version of Mathmind

In order to develop Mathmind there needs to be a team of:

- *Web database programmers*
- *Mathematician's*
- *Game designers*

At least 2 programmers and 2 mathematician's so they could help each other out. One game designer would be enough to do the work and would be the leader of the project. The cost of such a project would mostly be the salary of the team. No special environment would be needed as the team members would be able to work from home. A team of minimum 3 would be possible, but a team of at least 5 would be preferable if not more as the project needs a lot of man hours to be fulfilled.

It will not be hard to develop *Mathmind*, but it will take a long time to find/create non copyrighted math exercises and sorting everything into a manageable system.

The project needs to be supported by donations as it's main goals is to be free for everyone to use.

### *Mathmind* proposed development order

1. *School book system*
2. *Achievement system*
3. *Dueling*
4. *Interface*
  - *Writing with LaTeX*
  - *Sketching*
  - *Dragging sombols*
  - *Keyboard shortcuts for everything*
  - *Graph Calculator*
5. *Calculate or play with other people.*
6. *Graphics for showing how equations work.*
7. *Mobile software for Mathmind.*

## Discussion and Conclusion

The prototype of this project was meant to show how *Mathmind* would work. As I had no knowledge of webpage programming, I had to try to find out what programming language, platform and software to use. There was a lot of different systems of how to create webpages, but creating a database for the page was complicated. I did not have time to delve to deep into learning such a system as the pure design and ideas was the important part and would take a lot of time to create. After much investigation I tried to learn *Flash* as many are using this for more advanced things such as programming games etc. After a full week of learning *Flash* I came to the conclusion that using this solution for this project was not working as intended. I could not find any database related programming information which made it a lot harder to visualize the information. I needed a much faster way of visualizing the project so that time could be used for designing the page. More time went into searching for a more efficient solution. Every way of trying to create a prototype seemed to involve foreknowledge of database programming. My final hope went into trying to use a Wiki-system and find already created modules which I could ad to the page. Unfortunately I could not find any modules suitable for this project.

When I could not find any way of prototyping the page I tried to visualize the ideas instead. I made a visual representation of a login screen and made it possible to click login. This would not register the user but at least give a understanding what should happen if it worked.

Once inside the page, many more dilemmas came to view. It was very hard to structure the page as

I had very little knowledge of math. In order to represent the page I needed a lot of math exercises and structures. Creating math exercises from thin air without any groundwork is very hard if one is not a really good, long time math teacher. So I had to try to find a math book with a structure which I could change a bit to fit the page. I finally found a book useful for this purpose.

At this stage one needs to modify the exercises to work within the page. This is where the structuring of the pages comes in. This is very time consuming work and at this point I wanted to do things like entering a value as answer for an exercise. This simple thing was not possible at all within the wiki-system even after I had gone through all modules available. Not being able to create such a thing made it really hard to further structure the page and get a true feeling of how it should look like. A prototype in the form of a real page is needed in order to understand what features can be implemented.

Even though the prototype was not possible for me to build in any effective way, I think the idea behind the math page still is very good and can be developed with more experienced people..