

Grass Roots Project Report

Using MathsNZ Students to Engage Students in Mathematics

Jake Wills - Kāpiti College

Table of Contents

Introduction

Background

Objectives / Inquiry questions

Background reading / Literature review

Assumptions / Theories

Definitions

Methodology & Design

Methodology

Project Design

Phase 1: Statistics

Step 1: Create online lessons for the first Year 9 Topic, Statistics

Step 2: Get Initial Feedback

Step 3: Share with the Wider Mathematics Community

Step 4: Feedback Gathering and Other Changes

Phase 2: Number

Step 1: Create online tool for the second Year 9 Topic, Number

Step 2: Get Initial Feedback

Share with students and parents at my school

Feedback from Teachers

Feedback from Parents

Feedback from Students

One of the students also found a bug in the system which allowed them to get a super high score without getting many questions right. I fixed this and thanked the student.

General feedback from people at my school:

Step 3: Share with the Wider Mathematics Community

Phase 3: Geometry

Step 1: Create online tool for the third Year 9 Topic, Geometry

Step 2: Get Initial Feedback

[Share with students and teachers at my school](#)

[Feedback from Teachers](#)

[Feedback from Students](#)

[Step 3: Share with the Wider Mathematics Community](#)

[Data Generation / Collection](#)

[Data Analysis](#)

[Findings](#)

[Phase 1: Statistics](#)

[Phase 2: Number](#)

[Phase 3: Geometry](#)

[Discussion](#)

[Phase 1: Statistics](#)

[Phase 2: Number](#)

[Phase 3: Geometry](#)

[Limitations](#)

[Implications / Recommendations](#)

[Next Steps](#)

[Conclusion / Additional comments](#)

Introduction

Background

I am a secondary teacher at a large co-ed high school in the Wellington Region. I have spent the last 5 years developing digital resources that are available for free online for students including NZGrapher and MathsNZ, which are used by over 60,000 unique users every month. Throughout this project I asked for feedback from students and teachers around the country, with the idea to be to get a wide variety of feedback from various different learning and social backgrounds.

The reason I wanted to complete this inquiry was there has been a large level of demand for what I have been producing, so I wanted to be able to do some more analysis around how effective what I had been producing was, and what I could be doing to improve the teaching and learning that was facilitated through MathsNZ Students.

Objectives / Inquiry questions

The idea would be to provide teachers with an online teaching tool that they can use to support their students learning, and provide an easy way for students and teachers to provide feedback so that the resource can be continually improved and developed. The inquiry question would be: “How do year 9 users rate tasks encountered on the MathsNZ site and what do they and their teachers say about the overall value of the site for teaching and learning?” We will also investigate “How can student and teacher feedback be used to refine the MathsNZ tool?”

The online teaching tool would consist of a series of online videos, notes and questions that get marked (where possible) and sent through to the teacher’s email for review and feedback. Based on the work I have already been doing on MathsNZ Students (<https://students.mathsnz.com>) which is available to all teachers and students in New Zealand for free, and is being used extensively (over 24,000 distinct users during 2016). This means that students are able to work in the times, places and contexts of their choosing.

Background reading / Literature review

In the limited timeframe available for this project, the team did not have opportunity to engage fully with the wider literature about digital learning in Mathematics, however I did do a small amount of reading around digital technologies in New Zealand.

In the “Future-focused learning in connected communities”¹ report it talks about “digital technologies offer[ing] exciting possibilities for students to learn at the times, places and contexts of their choosing”. By providing this resource to the students they are able to learn anywhere, anytime it means that students are able to engage with the learning in the contexts and environments that best suit them. Also by having the resources online it helps students to become a “confident, competent user of digital technologies” through increased exposure. By making the resources available for will be available for free on MathsNZ Students (<https://students.mathsnz.com>), they will be available forever for all students in the country to be able to use in the times, places and contexts of their choosing.

¹ <http://www.education.govt.nz/assets/Documents/Ministry/Initiatives/FutureFocusedLearning30May2014.pdf>

My project also lines up with the Achieving the New Zealand Education in 2025: Lifelong Learners in a Connected World² document which talks about “education resources [being] instantly available” to students to allow easy access to high-quality resources. It also helps teach students to learn, by providing them with an outline to follow and the ability to be able to dive into certain areas in more depth than others.

My project also ties in with the new bill proposing COOLs (communities of online learning) by demonstrating a way that you can “enable children and young people to access their education through online delivery”³ by building on my MathsNZ Students (<https://students.mathsnz.com>) platform that has already shown to be hugely popular with teachers and students as shown in my last enquiry.⁴

“Digital technologies are transforming how we live – shaping our homes and our workplaces, and changing the way that we interact with each other and live our everyday lives.”⁵ Mathematics is the foundation for all digital technologies, and these tools that I have created and are creating will help support students with the underlying principles needs to learn about digital technologies which is particularly relevant with the changes coming with the new Digital Technologies curriculum.⁶

Assumptions / Theories

The inquiry starts from the assumption that by having the work online, students, teachers and caregivers are able to see from the start of the topic what they need to cover and plan accordingly to be able to best maximise their learning. This means that all stakeholders (family/whanau, students and teachers) are immediately on the same page, and the best support can be provided to the student to maximise the outcomes. At any time students are able to rate the task on a 5 star scale (no descriptors are given for this so students can interpret the 5 stars as they see appropriate - the idea is to keep it as simple as possible), and optionally provide feedback for improvement and suggestions. Teachers would also be able to use this to feedback ideas to be continually improving the resource to make it as effective as possible for the students.

I have made the assumption that teachers will be using the tool to support their teaching, and working alongside students, rather than using it as a replacement for their teaching. I do however know that by putting this tool online for students and teachers to access freely, I have no control over this.

² <http://www.education.govt.nz/assets/Documents/Ministry/Initiatives/Lifelonglearners.pdf>

³

<http://www.education.govt.nz/ministry-of-education/legislation/the-education-update-amendment-bill/establishing-a-regulatory-framework-for-online-learning/>

⁴

https://docs.google.com/document/d/1I2kkKB0OzQBjzNeMsrqk-16OFv_tY4JYTERV6UGSXQ/edit?usp=sharing

⁵

<https://education.govt.nz/assets/Documents/Ministry/consultations/DT-consultation/DTHM-Curriculum-Factsheet-for-Teachers-2017.pdf>

⁶

<https://education.govt.nz/ministry-of-education/consultations-and-reviews/digital-technology-consultation/>

I also went into this with the assumption that the use of these online tools will be effective, which could lead to a bias in my results.

Definitions

Throughout this report I refer to a number of various terms. I have endeavoured to detail these below:

- **Inquiry learning:** An inquiry based approach is driven by students' curiosity about the world around them. It encourages connection, co-operation, and collaboration by allowing students to pose and solve problems together and with their communities in shared, authentic learning experiences.⁷
- **Digital tools:** Digital tools are electronic tools, systems, devices and resources that generate, store or process data. These includes social media, online games and applications, multimedia, productivity applications, cloud computing, interoperable systems and mobile devices.⁸
- **Student voice:** student voice is any expression of any learner about anything, anywhere, anytime related to learning, schools or education.⁹
- **Task:** In this report a task refers to a single activity on MathsNZ Students.
- **Module:** In this report module refers to a group of tasks around a topic on MathsNZ Students.

Methodology & Design

Methodology

The methodology for this study was primarily qualitative as it studied the experiences and reflections of students using the site and did not seek to generalise the findings, but there was quantitative element as well with the collection of ratings for each task and overall ratings at the end of the study.

Project Design

This project involved a number of steps that were repeated several times. A summary of each of these steps is given below.

- Create online lessons for year 9.
- Show students the site, and allow them to work through it, monitoring feedback from them and teachers as they go, and adapting the resource as they go based on the feedback received.
- After students have completed the topic they will complete an online survey asking how they found the learning using the resource.
- The results of the survey, how students performed in their assessments, and the feedback received throughout the process will all be analysed and looked at.
- The feedback from this would then be used to review the current set of tasks and adapt them as needed, and to continue to develop a new tasks.

⁷ <http://elearning.tki.org.nz/Teaching/Future-focused-learning/Student-inquiry>

⁸ <http://www.education.vic.gov.au/school/teachers/support/Pages/elearningcurriculum.aspx>

⁹ <https://soundout.org/definitions-of-student-voice-2/>

This process was then repeated in a cyclical fashion as new feedback was received. As an continually evolving product will mean that it will always be seeking to be as relevant and useful as possible in the constant move towards a platform that is useful as possible.

During this inquiry I was able to complete this cycle 3 times for 3 different Year 9 topics, once for Statistics, once for Number and once for Geometry.

Phase 1: Statistics

Step 1: Create online lessons for the first Year 9 Topic, Statistics

This ended up taking slightly longer than I expected, as it involved creating 2 new types of questions and working out how to code them in... these are drag and drop questions, and dropdown questions.

These are all available online here: <https://students.mathsnz.com/9.10>

I also took on board the feedback from last year's enquiry cycle about the sound quality of the videos and have invested in a couple of new microphones which had various levels of success, and also consulted with some people who knew a lot more about microphones, and by the last videos in the series I had managed to sort out the sound and video quality to a level that was significantly better than last year.

Step 2: Get Initial Feedback

I have started by rolling out the program to students at my own school, and getting feedback from teachers and students across different classes.

One of my students found a typo in one of the lessons, this has now been fixed. There were also a few other typos in the lessons and one drop box that didn't have anything for it, but these errors have now been fixed as well.

The initial feedback I have had so far from teachers and students has all been very positive. The students have been finding the ability to work at their own pace very good, and the teachers have really liked having everything easily accessible for them.

One piece of feedback that has come back is putting in the lesson number at the top of what is sent through to the teacher to make it easier for them to keep track of it. This is something I will look at implementing at some point soon.

Step 3: Share with the Wider Mathematics Community

After the success of my small scale feedback trial, I have shared the following post on the MathsNZ Facebook page and will see what teachers are keen to get involved.

 **Maths NZ and NZGrapher**
Just now · 🌐

I've just put the finishing touches on my online Year 9 program on MathsNZ Students.
<https://students.mathsnz.com/9.10/>
I'm looking for a few teachers from a few different schools to help get feedback from their classes about what does and doesn't work for you... If you are going to be teaching Year 9 statistics this year and want to get involved with your students, then let me know.

I will send out the following email to the people that are interested.

Hi there,

Thanks so much for volunteering to help out with the trial for 9.10 Statistics.

I have just finished the last of the lessons, so they are now all good to go on <https://students.mathsnz.com/9.10/>
If you find any errors please let me know so I can fix them, or if you have any suggestions for improvement please let me know.

Just a reminder, if you haven't already done so, you'll need to sign up to MathsNZ Question Generator at: <https://students.mathsnz.com/qg/signup.html>
This means as the students complete each task they will be able to email the completed tasks through to you.

After watching each video or completing each set of questions I'd really like it if the students could use the stars at the bottom to rate each task... they can then optionally give a reason why they gave it that rating... if you could please remind your students of this that'd be great :)

Once they have finished the topic and done whatever assessment you are going to give them, if you could send me through some general feedback about how you think they did, and their general understanding levels compared to previous years, and get the students to complete this survey: <https://goo.gl/forms/wUrAp81sEDScMdX83>

As always, let me know if you have any questions.

Cheers,
Jake.

I will then monitored feedback on a regular basis to see how students were finding it as they went through.

The sample size of students using the site was quite large, from March through to July this year MathsNZ Students has been used by 17,691 unique users from all over New Zealand. For this topic 77 students ended up completing the survey from at least 3 different schools.

Step 4: Feedback Gathering and Other Changes

Throughout the inquiry I asked for students and teachers to provide feedback, both via email and through the feedback on the website. Looking at the feedback from students throughout the inquiry it is all largely positive and fairly general, particularly when looking at the reasons given, but did lead to the following changes:

- One of the teachers suggested it would be best to make the lesson numbers show at the top of what is sent through from MathsNZ Students to the teachers' email addresses.
- I fixed the bug with iPads and Android tablets that stopped the drag and drop on the questions working, as iOS doesn't support native drag and drop in the HTML5 spec.

I also sent a survey to those students who participated, as well as asking a senior student to interview a sample of students to get their opinions on how they found it.

Phase 2: Number

Step 1: Create online tool for the second Year 9 Topic, Number

One of the big issues that we see with Year 9's mathematics is the lack of knowledge of basic facts. What I have therefore done is created a tool which covers addition and subtraction up to 20, and multiplication and division up to the 12 times tables.

This tool is available online here: <https://students.mathsnz.com/qq/>

Students can complete it as many times as they want each day, and their highest score each day will count towards their form class scoreboard.

I decided that I really wanted it to become a competition between the form classes as this will encourage the students to be encouraging each other to do it, and the more the students practice the better they will get.

Step 2: Get Initial Feedback

Share with students and parents at my school

I decided the best place to trial this would be at my own school... so have started a Year 9 competition between the form classes. The email below went out to the teachers, parents and students in Year 9 at my school:

Dear +++++

Re : ++++++

We have just launched a new competition for the Year 9 form classes. Each day students can go to <https://students.mathsnz.com/qq> and spend 5 minutes answering as many questions as they can. The questions are a mix of addition and subtraction up to 20, and multiplication and division up to the 12 times tables.

Each time a student completes the quiz they can save their score, and for every one question they get right this gets added onto their form class' total score. On 22 May (start of Week 4 next term) the scores will be recorded and these will count towards the Year 9 trophy.

A student can complete the quiz as many times as they would like between now and then, and their highest score each day will count towards their form class' total score.

When it asks for a login, the login is just the same as for the school computers.

The reason we are doing this is good knowledge of basic facts is one of the key skills that makes mathematics further up secondary school more accessible, so by practising now we are able to build and reinforce these skills.

You can also keep track of how all the form classes are going at <https://students.mathsnz.com/qq/scoreboard.html>

If you have any questions or feedback on this please do not hesitate to get in touch with me or +++'s maths teacher.

Kind Regards,
Jake Wills

co-HOD Mathematics, Head of e-Learning
Kāpiti College
Margaret Road, Raumati Beach 5032

Feedback from Teachers

One of the teachers came back and said:

Hi there, I have just completed the quiz, couple of errors! 117/119 I think.

reflection is that it could be a little long, 1/2 way through it felt like, hmm am I going to keep up this effort for another 2.5 minutes.

Maybe a 4 minute thing might be better? Just and Idea.

Cheers

I agree with him, so have dropped the time down to 4 minutes.

Feedback from Parents

I received a number of positive emails from parents... these are a couple of them

What a great idea to boost speed of recall of basic facts by making it a competition; I hope you see good results from this initiative.

Thanks. Sounds fun. I'll show ___ tonight. I'm sure she will be keen.

Feedback from Students

There was some confusion as to the authentication being "what day of the month you are born on?", as students were putting in the month rather than the day... I have bolded the word "day" to make it more clear.

One of the students also found a bug in the system which allowed them to get a super high score without getting many questions right. I fixed this and thanked the student.

General feedback from people at my school:

I have also sent out an email to students asking for some feedback on how they found the quick questions on MathsNZ

Hi <First> <Last>

We have recently finished the Year 9 Maths competition on basic facts, and as part of the ongoing improvement to MathsNZ Students I would really appreciate it if you could please fill in this survey:

<https://goo.gl/forms/KNSjbb7xbHDKclLm1>

It will take you less than 2 minutes.

Kind Regards,
Jake Wills

Step 3: Share with the Wider Mathematics Community

I sent an email out to my subscriber list:

I have also developed a number quiz that ties in with KAMAR which lets different form classes compete against each other... you can see it at <https://students.mathsnz.com/gg/>. If you want this set up with your school let me know.

From this we got 5 schools who signed up to use the service.

Phase 3: Geometry

Step 1: Create online tool for the third Year 9 Topic, Geometry

The next topic that was up was geometry. I have used the feedback that I have gained from the last several topics to fine tune the creation of the tasks and videos, and this series of lessons covers all the the Year 9 curriculum for Geometry.

This tool is available online here: <https://students.mathsnz.com/9.9/>

Step 2: Get Initial Feedback

Share with students and teachers at my school

I decided again the best place to trial this would be at my own school... so have shared the resources with the teachers at my school, who have in turn shared it with their classes.

Feedback from Teachers

One of the teachers came back and said:

Jake! Geometry videos amazing

Thanks 😊

It's perfect combined with projects and I pull out groups one at a time for tutes

It's the perfect system

Right now anyway

Awesome, that's great to hear.

For that teacher the videos and online questions were meaning she was able to run small group tutorials for the students that need them, and spend more time interacting in meaningful ways with her class which was fantastic.

Feedback from Students

One of the students noticed a glitch in one of the exercises, which I fixed, but the overall initial feedback from the students was really positive, as they liked being able to learn at their own pace and go over things they needed to spend more time on.

Step 3: Share with the Wider Mathematics Community

I shared the following to my MathsNZ Facebook page



The post received a large number of likes and was re-shared to a few pages.

This also led to an interesting discussion on twitter around the use of NAME for grading assessments in the junior school

Teacher:

Thanks for sharing! Not sure I like the idea of using A/M/E for juniors (ie anywhere we're not absolutely required to) tho...

*I definitely don't like it, but I know some schools use it & it's consistent w/ NCEA so a helpful benchmark for kids & beginning teachers...

But I DO like that you make awesome resources and generously share them... just to clarify :p thank you love your work

Me:

We use the A/M/E at our school, as do about 50-60% of the schools I work with...

Teacher:

Yeah we use it in some curriculum areas too... but I still don't like it :p

Me:

Yea... we've been having big discussions around assessment & reporting in Y9 & 10 (& senior school) as in NZ we seem to assess a lot!

But it is basically A: unistructural, M: relational thinking E: extended abstract thinking... so you can link to whatever reporting you want

Or for the stats standards: A: using, M: justifying, E: showing insight

Teacher:

Cool. Ours isn't this well thought through, it's more of a relabelled A/B/C system :p

Data Generation / Collection

The data was collected in four ways. Firstly, there was informal feedback that came in from teachers and students via email. Secondly, there was the star rating system on each task as well as the comments after the rating was given. Thirdly there was the surveys done of students at the end of the topic on Google Forms that was emailed out to all participants. Finally there was a face-to-face interview conducted with students by a senior student in the school.

Data Analysis

Every time the feedback data or the survey data came in I coded the data by identifying key points from the data and then summarised this into themes based on the main comments that the students made. I also applied this to the interview that was conducted with the students.

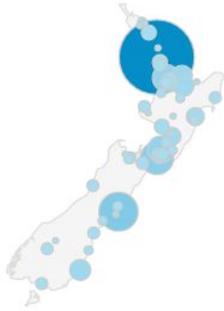
For the quantitative analysis I took the 4 point or 5 star scale and drew it as a bar graph using the Google Forms or NZGrapher.

Findings

My project had 3 distinct phases, the findings from each one is detailed below.

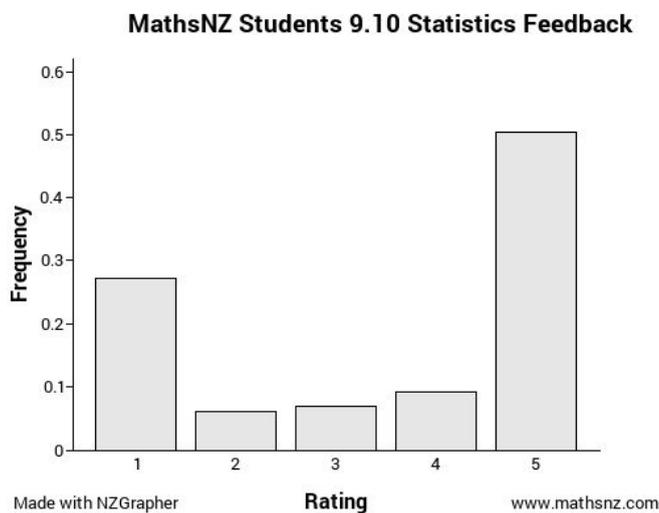
I have received a large amount of feedback from this from many different schools now. From March through to July this year MathsNZ Students has been used by 17,691 unique users

from all over New Zealand. Many of these users visited the site multiple times.



Phase 1: Statistics

The feedback received from the star ratings has been largely positive, with just over half of all responses being 5 stars.



The most common themes of feedback from the 5 star feedback section were comments about how clear and easy it was to understand such as:

- Clear Concise Clean Love it for my students
- Amazing good explanation
- Very informative
- I love this website it's so useful

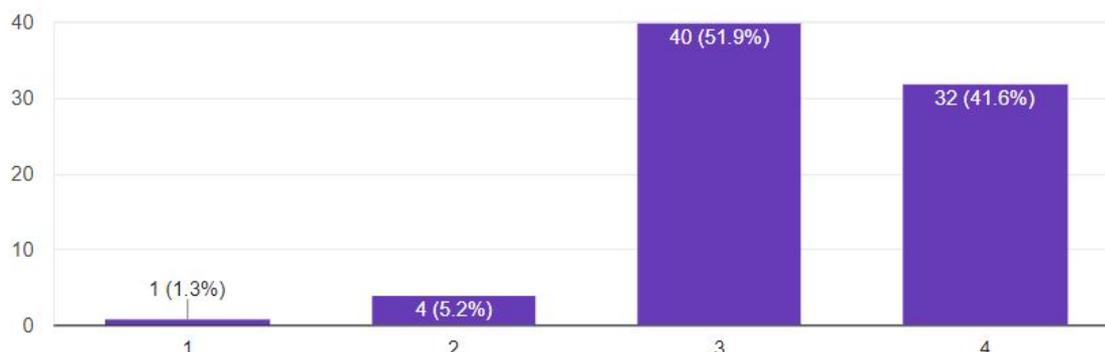
There were also a number of comments about how helpful it was you could check your own answers.

There were also some suggestions for improvement. Several people suggested adding subtitles to the videos. An early piece of feedback was the drag and drop didn't work which has now been fixed. Most of the people who gave feedback of 1 just put in spam comments.

I also managed to get 77 students from 3 different schools to complete the survey. They almost all said that learning through MathsNZ Students was better or a lot better than normal.

I found using MathsNZ Students for learning this topic

77 responses



The positive feedback that was given were around these themes:

- Students could access the resources any time, which meant they were able to do it in their own time and also refer back to things later when they needed to.
- If students “messed up” you could try again
- If students didn’t understand you could watch the video again, without feeling bad about asking the teacher for extra help
- It was simple and easy to use
- The videos and explanations were really easy to understand
- The quizzes straight after the video really helped reinforce the learning
- It was more fun
- The work didn’t get lost in the process as it was all online
- “We could really just get on with it more independently” which meant students could move on and they didn’t feel like they were being held back by the rest of the class.
- Some of the students found the videos much better than reading
- It was “far more engaging than text book work”

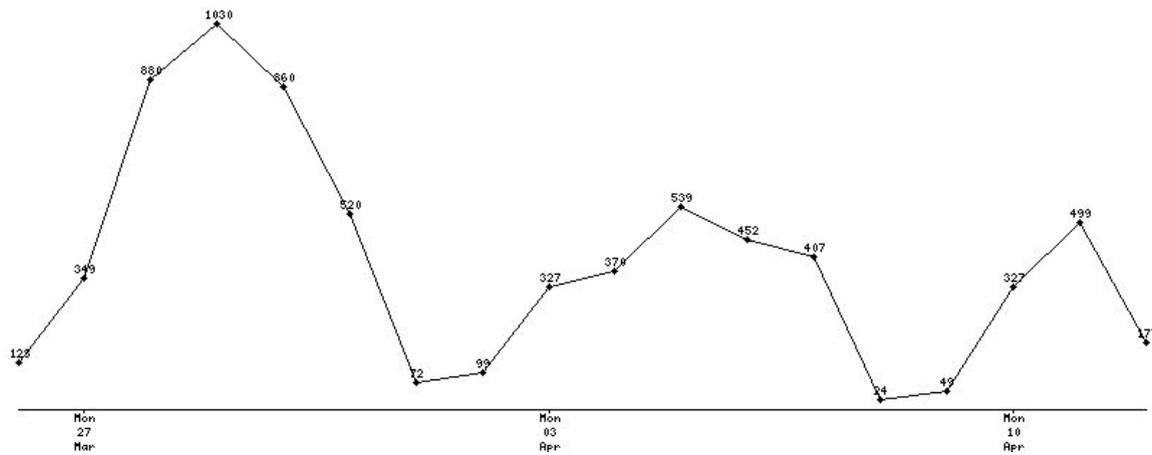
Some of the things that students suggested for improvement were

- The vast majority of students answered this question with “N/A” or “Nothing”
- Issues with the drag and drop (now resolved)
- It wasn’t “pretty” enough (which I have endeavoured to improve)
- There was one student who didn’t like needing to use a computer
- One of the students complained they could cheat by having two tabs open at once to look at the notes while completing the questions... I have no idea how to solve this.
- Some found it slightly boring
- “The voice may have gotten a bit annoying but it’s a small price to pay for the benefits of MathsNZ”
- Some students complained they needed more time for the exercises (which would be a classroom structure thing)
- Let the lessons be available to download so students without internet can do their homework at home

- Try add a recap lesson at the end of longer lessons, just so people know if they are actually learning or if they are getting overwhelmed and/or distracted.
- A reward if we complete the tasks perfectly.

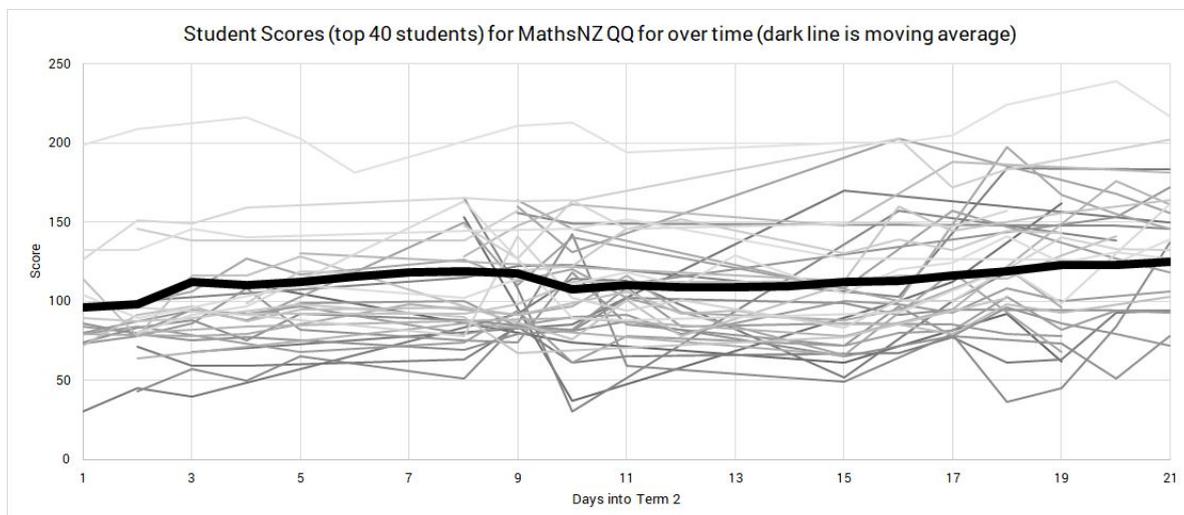
Phase 2: Number

The teachers and students have been really participating in the competition, with over 900 daily scores being saved in the first 2 weeks of the trial (if a student does it more than once in a day this still only counts as one in this metric), and the scoreboard and the quiz being accessed in large numbers, as shown by the graph below. The teachers have been saying they have never seen students so keen to do maths in their lives.

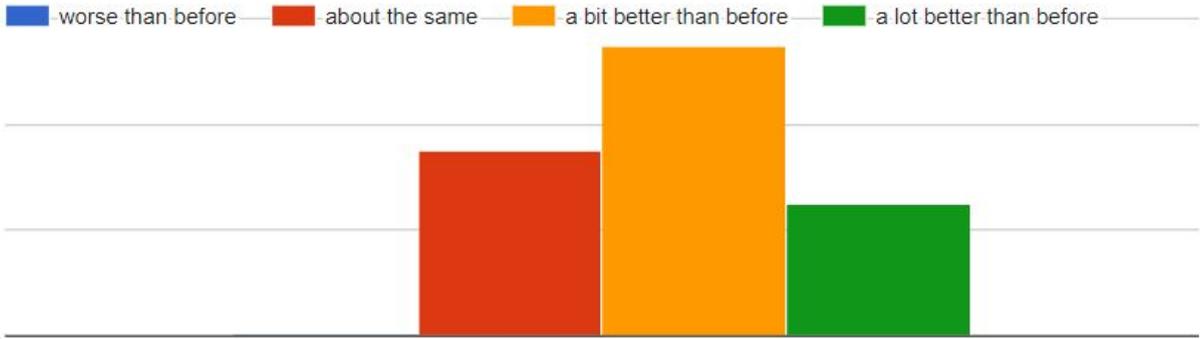


At the end of the competition there was a huge spike in the usage on the site, with 3,500 quizzes being completed in one day (many students did it multiple times to try get the highest score possible).

I collected the scores for the last 3 weeks of the competition for the 40 students who did the quiz the most over that time. The average number of questions that the students got correct over this period of time increased by 30%.



The feedback from students was either that they felt they were no better than before, or they had improved



The key themes from the students were:

- It was fun to use
- It got students’ “brains working”
- It got students into the habit of doing the questions daily
- There was a “rush” when you got a high score
- It was really good being competitive

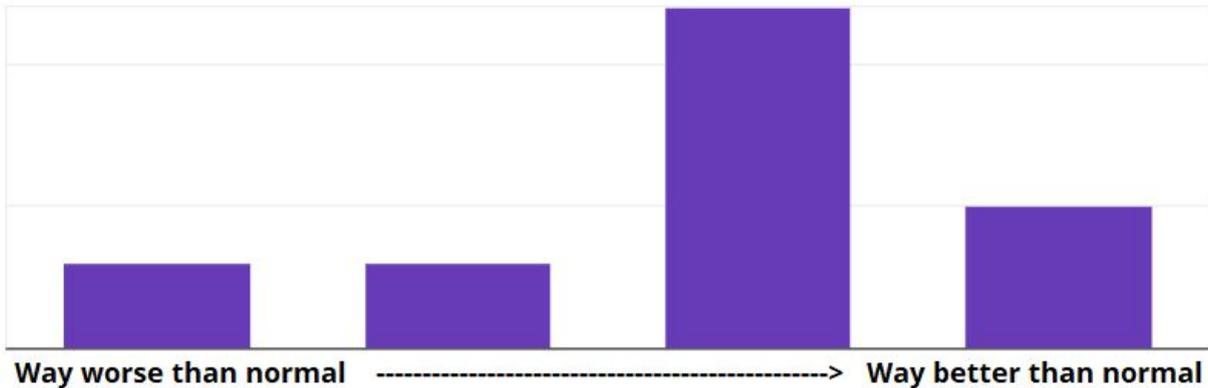
The one thing the students didn’t like or felt could be improved on was:

- There was some hacking going on to get higher scores which frustrated some students... I was aware of this and stopped most of the bugs now I think.

Overall the students commented they found it helpful, with many commenting they felt their basic facts were a lot better than they had been.

Phase 3: Geometry

The feedback on this topic has been slightly more mixed, with 26% of students saying they found learning this way either worse than normal or a lot worse than normal:



The key themes of the things that students found good about the site:

- It was step by step and easy to use, simple / easy to understand,

- It was fun and enjoyable
- It wasn't boring like the text books
- The drawing part was really good

The key themes from the suggestions for improvement were:

- One student commented on the fact that they just prefer to use a text book
- Sometimes the questions were hard to understand
- The drag and drop issues (again now resolved)
- One student found the amount of work overwhelming

One student commented they couldn't ask questions of their teacher.

The key themes that came through on the suggestions for improvement section were:

- Adding more colour / flare
- Getting the site to be able to mark all questions (some the teachers have to mark as they were rather difficult to program in the marking)
- Make a popup to help if you get a question wrong (which I thought was a really good suggestion)

Overall, 74% of the students that responded to the survey found learning this way better than what they normally would have in class.

Discussion

Phase 1: Statistics

One of the most common pieces of feedback I received was around adding subtitles to videos. While this is a good idea, the cost and time involved in this make it unfeasible at the moment. If I had a large amount of extra funding this would definitely be something that would be worth looking into.

While the project was not perfect, and there were a number of things that I learnt, overall I am very happy with how the Statistics project has worked out. For these students it appears they found this way of learning beneficial, with 72/77 students responding to the survey stating that they found learning this way “better” or “way better” than usual.

The process of getting feedback as I was developing the tool was also very helpful for me as a teacher, as I was able to take the feedback the students and teachers were giving me and apply it to the next lessons that I was working on.

Phase 2: Number

The 30% improvement in scores for students actively using the tool was really good to see, and reinforced for me just how effective the practice of basic facts can be.

The other positive from this was the engagement from the students with doing these tasks. The teachers that commented they have “never seen students so keen to do maths in their lives” was hugely rewarding to hear, as this whole project was about making students engage with mathematics.

Phase 3: Geometry

The area that was of greatest concern to me was the student commented they couldn't ask questions of their teacher. The idea behind this tool was that it would be used to support the work of a teacher, not replace them, however because I am making the resources available to anyone on the internet there is no way to enforce that this is done.

From this group of students, 74% of them responded saying found learning this way better than what they normally would have in class, which while not as high as some of the other modules still is a result that I am happy with.

Limitations

It is not possible for the findings from one small-scale inquiry to be applicable generally (i.e. assumed to be true for other participants, or other contexts). This is particularly true of the qualitative approach that I have largely been doing during this study.

I am aware that there was also limited time to do background reading and relate these findings to the wider context. As only a minimal literature review was attempted it would be interesting to carry out further reading to discover how our findings align with other studies.

For some of the sections the response rates were not as high as would be ideal, with all surveys having less than 100 respondents. Due to the high rate of non-response to the surveys it is possible the results are skewed in one direction.

Also, as students at times were interviewed in by a senior student, they might overstate their levels, and the Hawthorne effect may have come into play when students were interviewed in groups.

I will also be biased towards making the report look good because I was doing the research and I believe these methods are effective.

On reflection I didn't do as much as I would have liked to have done in this project, the original aim was to cover the entire Year 9 curriculum, and I managed to write 3 modules. The time it takes to prepare and analyse these resources is a major limitation.

Implications / Recommendations

From my small scale study it appears that what I have created has been useful for the teachers and the students involved. Students appeared to have increased learning outcomes and this was commented on by both parents and students.

Digital tools are changing the way we live, and a good understanding of mathematics is at the heart of a good understanding of digital technologies. These tools that I have created and are creating will help support students with the underlying principles needs to learn about digital technologies. This is particularly relevant with the changes coming with the new Digital Technologies curriculum.¹⁰

¹⁰

<https://education.govt.nz/ministry-of-education/consultations-and-reviews/digital-technology-consultation/>

The biggest concern I have about these tools is how teachers use it: the idea that I have is that this would be used with the teaching philosophy of social constructivism however what I have created is a tool that is quite behavioural. If it is used well by teachers then I believe it will be very helpful, however as I am making it available for free on the internet, I have no way to ensure that students are supported by their teachers. This tool, while useful, will never be a good replacement for the relationship with a teacher.

Next Steps

I will continue to develop MathsNZ Students, along with MathsNZ Teachers and NZGrapher, as I believe they are exceptionally valuable tools for teachers and students, and are being used by tens of thousands of students around the country every week.

The things I plan on taking forward when producing new resources would be

- Looking at adding a reward system
- Making the lessons available for download so students without internet can do them at home
- Adding short recaps at the end of the videos
- Improve the drag and drop exercises
- Make a popup to help if you get a question wrong.

Some of the things that I think would be interesting to investigate would be:

- I believe it would be interesting to do some investigation into how teachers are making use of the resources. I believe it would lead to an increase in one-on-one time between teachers and students, but it would be interesting to see if this is indeed the case.
- It would also be interesting to investigate if students are actually doing what they are meant to when they are set an online task?
- Another question would be does having the work online actually allow students, teachers and caregivers are able to see from the start of the topic what they need to cover and plan accordingly to be able to best maximise their learning? Also, does it allow students to work in the times, places and contexts of their choosing?
- Does students giving feedback help improve engagement with the site?
- It would also be interesting to investigate if adding subtitles to videos help with student engagement and learning.

One of the other things I have just started doing as well is getting the students to create the videos, with help from me. The initial feedback on this has been really positive, both from the students creating the videos and the students watching the videos. It will be interesting to see how this progresses as I start to do more of this.

Conclusion / Additional comments

I believe this project has been an exceptionally worthwhile one, and has led to some interesting findings, and has also created some really valuable resources for all teachers and students to be able to access and use.

Throughout this project I have been supported both by the teachers and students in my own school, but also teachers and students throughout the country. Without their support this project would not have been possible, so I want to say a large thank you to them.

My work on this however is not completed, and the nature of this work means it never will be. My work on these tools started well before the Grass Roots Ideas Initiative, and will continue well after the project ends. I will continue developing MathsNZ Students, MathsNZ Teachers and NZGrapher to support the tens of thousands of students throughout New Zealand that use them every week. They are a labour of love for me, and are virtually entirely self-funded, both in terms of the financial resources to keep the sites running and the time required to develop them, but I continue with them because I know they are so valuable for the teaching community.