Equals

Realising potential in mathematics for all

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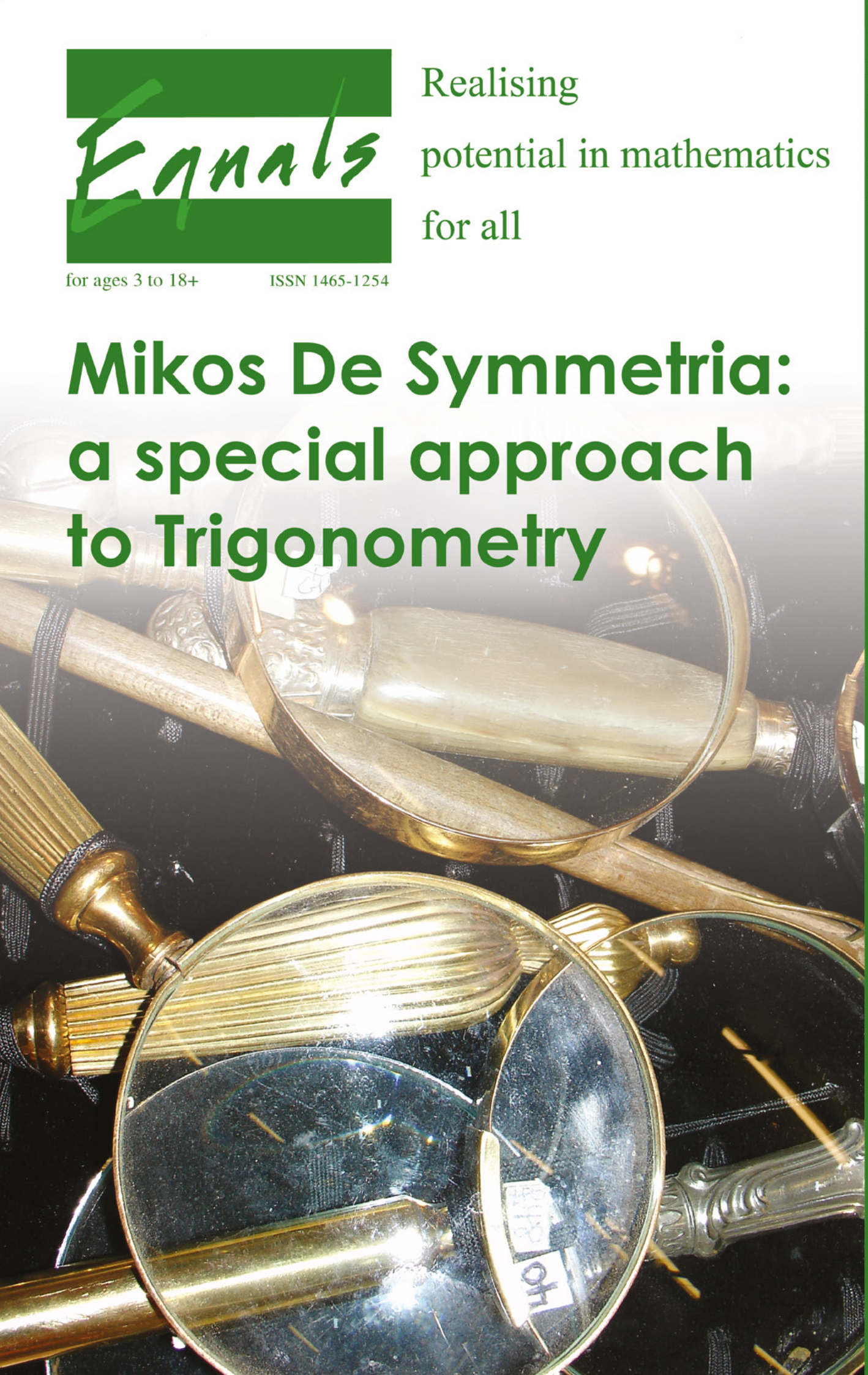
Mikos De Symmetria: a special approach to Trigonometry



Equals

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Designed by Nicole Lane

Editor's Page

It gives me great pleasure to share this issue of *Equals* with you.

I would like to draw your attention to the article by Sameer Sharma, a 14-year-old student from India. He is an incredibly keen mathematician and it is a real privilege to publish his work. This issue's Maths Talk is with a Nichola, a hospital teacher, and the similarities in her advice and that of Lynda Maples is quite striking. Mark Pepper has supplied two pieces for us; one on visual impairment and another reflecting his thoughts upon a most curious read. Rachel Gibbons has kindly reviewed Dylan Wiliam's key text Embedding Formative Assessment for us. Louise Gowan continues to share her experiences from life in a special school while Mary Clarke highlights the importance of concrete physical experience in the learning of mathematics.

Moving forward

The last six months have been very interesting for *Equals*. A real sense of direction, and purpose, has emerged and I am happy that *Equals* has a way forward after the successful stewardship of Ray Gibbons.

We have received a number of contacts and these have shaped both my own thinking and the future direction of this publication. The most significant one came in the form of an email and phone call from Barbara Rodgers of the Solent Maths Hub. Barbara got in touch to ask for help with a SEND conference. The conference is seeking to provide support and guidance for mainstream pupils who are struggling and attaining well below that expected for their age. This was also coupled with an invite to a SEND meeting to which all Maths Hubs were invited. I am pleased to report that Lucy Cameron, who was there to represent the Great North Maths Hub, was able to speak on our behalf.

The outcome of the meeting was an overwhelming sense of purpose in increasing the focus upon SEND pupils among the Hub's. It was felt that Equals can play a key role in this network and that a forum needs to exist to share ideas and network. I feel that Equals is ideally positioned to shine a light upon the good practice that is taking place in special schools. Many issues were discussed such as the importance of accreditation for older students, while there is also a pressing need to share what 'mastery' might look like for SEND pupils.

I am also pleased to report that the support for *Equals* is strong enough to have an editorial board meeting. A detailed summary of the outcomes of this meeting, which will shape the direction of *Equals*, will be reported in the next edition.

Assessment without levels

Louise Gowan **has been teaching in a special school for many years. As part of a series of articles she shares the highs and lows of working with those for who this publication was devised.**

20 years ago I spoke at NUT conference against the National Curriculum and testing, outlining the dangers of a narrowing of the curriculum and a move toward teaching to test. This has happened but the emphasis on levels has had further consequences.

Levels have been problematic. Children have become defined by their levels and use levels to describe their achievement and progress, saying 'I am a level 4a' rather than talking about actual skills they have learnt or work they have completed. Work on walls is often levelled and some walls have levels with names against them to show where pupils are. All of this is a misuse of levels where a simple number is used to describe a pupils' achievement in Maths. For pupils such as ours who achieve below that expected for their age the whole system is very de-moralising and de-motivating.

Schools have become exam factories with success governed by test results.

Levels have been used to create or encourage competition between pupils, teachers and schools. They have been used to create unrealistic targets which become the main aim of the pupil, teacher and school. We have moved towards teaching by number, teaching toward numerical targets which then determine our success as teachers, our pupils' success as learners and our school's success in OFSTED with the threat of failure forever nearby.

As levels have become the main purpose of education there has been a move back to teach to test, learning by rote, exam practice for a large part of the year. Schools have become exam factories with success governed by test results. The effect on the curriculum has been an emphasis on the 'core subjects'-Maths, English and Science and a narrowing of the curriculum with creativity and investigation being the inevitable loss within this framework.

Everything I worried about 20 years ago has come to be.

As a SMILE teacher of 30+ years I have always used levels. They were a guide to where a pupil was and gave a starting point for what work to set. In SMILE every task was levelled and recorded on a grid which showed every task completed by an individual pupil, and recorded their success through a short test on each task following completion of a matrix of 10 tasks. It was a very thorough system. Although levels were used consistently they were never the main focus. They were useful and used as a guide but not restrictive.

Levels are a useful way to compare pupils against each other and to assess individual progress. Pupils should know where they are in their learning

and what they need to learn next. Levels can be used as a hierarchical structure or container with the mathematic content being held within it and providing the food, the main purpose of the learning. The problem has been the use of publicised results which set pupil against pupils, teachers against teachers and schools against schools and set higher and higher targets. This has led to unrealistic and very naïve interpretations of achievements, averages and tests. Levels are a way to track progress which is useful to both teacher and pupil to share achievements if used appropriately.

Assessment without levels is not what is actually happening. A variety of systems will now be put into place which is likely to make it more difficult for parents to understand how their children are doing and potentially more confusing too for pupils and teachers. The debate continues around the level of detail that is useful in describing what a child knows and how this relates to learning intentions and success criteria. Some systems will replace numbers with statements and perhaps even use some qualitative rather than quantitative data. There may be good systems being developed but some systems are going to be even worse than that which they replace. In some instances pupils are now being assessed against age appropriate 'fundamentals', very similar to the key objectives of the original National Strategy. Instead of being a 4a they will now presumably talk about being at, below or above age appropriate. My year 8 class are working at reception/year 1. Is it better to talk about them working at year 1 rather than being on a 1b? Pupils are being assessed according to the percentage of fundamentals for a year that they have covered. For example a pupil having been assessed as understanding 25% of the fundamental statements as year 2 may be assessed as 1.025 as if a descriptor with 3 decimal places is a more accurate assessment of progress. While there is an attempt to reassure teachers that their professional judgement is important and that a variety of evidence should be used to make a judgement my guess is that standardised tests will be used to confirm judgements but maybe I have become overly cynical over the years.

Some schools are, I know, using this opportunity to be more creative in their assessment and this has to be a good thing. Discussion and debate in education is important and I hope that this will be used as an opportunity for some education professionals to take back the initiative and develop assessments that make sense and that can replace the old system of levels successfully.

A is not good enough for the 'top' stream, outstanding is not good enough for the 'top' schools.

I can't remember now which secretary of state for education started the notion of everyone being above average but this misconception persists. The abandonment of levels had some good theory behind it but in effect we are still working to making sure all achieve above average. Only the high achievers will feel good, and even there the pressure is to be forever better. The pressure is on to continue to improve. A is not good enough for the 'top' stream, outstanding is not good enough for the 'top' schools. We have always to look beyond 'what went well?' to 'even better if'. A* and world class are now common targets for many. It would be nice if we could get the message across that we will never all be above average and actually

that is a good thing and good is good enough. For the moment the target is still there and the evidence is there to show that both pupils and teachers are under increasing stress and presenting with concerning levels of mental health problems in part due to the ridiculous pressures inherent in our present education system. I am pleased to say that many, in fact I would hope most, of my pupils still enjoy their maths lessons and for me this is an evaluation of my success as a teacher. I am struggling to keep stress at bay and enjoy the experience of being in a classroom and engaged in learning with my pupils. While my classes are happy and engaged in their learning then I am happy that they are making good progress.

The Curious Case of the Dog in the Night-Time (Re-visited after 12 years)

In this article Mark Pepper shares his mathematical reflections on a most curious book.

In 2004, shortly after this book was first published, Nick Peacey wrote a review of it which was published in *Equals*. Nick gave the book fulsome praise and dealt mainly with the general aspects of the effects of Asperger Syndrome. I recently read the book for the first time and largely agree with Nick's sentiments but it will now be considered from the perspective of its mathematical content. The book is written in the first person by Christopher, a 15 year old who has Asperger Syndrome. As a consequence of his condition he interprets everyday events in a highly unorthodox manner and yet he has huge reservoirs of factual knowledge and he is presented as having outstanding mathematical ability.

There is plenty of evidence supporting the proposition that Christopher is an outstanding mathematician. This includes an elegant algebraic proof and a sophisticated interpretation of a complex probability question. He also performs scarcely credible feats of mental dexterity in cubing all of the numbers up to and beyond 17, correctly calculating the product of 251 and 864 and solving quadratic equations with the use of the standard formula. Towards the end of the book Christopher, at the age of fifteen, takes an A level mathematics exam and gains an A grade.

Christopher has a particular interest in prime numbers which is evident by his choice of chapter headings which are represented by consecutive prime numbers 2, 3, 5, 7…

He describes his strategy for identifying prime numbers (p 14):

This is how you work out what prime numbers are.

First you write down all the positive whole numbers in the world. Then you take away all the numbers

that are multiples of 2. Then you take away all the numbers that are multiples of 3. Then you take away all the numbers that are multiples of 4 and 5 and 6 and so on. The numbers that are left are the prime numbers.

Page 14 also contains two diagrams to support the text. Both of these consist of a 10 x5 array in which the first consists of all of the numbers from 1 to 49 represented in each of the small squares and the fiftieth square contains the letters etc. In the second diagram only the prime numbers are included and again in the fiftieth square are the letters etc.

Clearly this is an extremely inefficient method of identifying a prime number. Once all of the multiples of 2 have been "taken out" then when Christopher attempts to "take out" multiples of 4 he will find that they have already disappeared! Hence it is pointless to consider any multiple of 2 to be a prime number. Similarly once all of the multiples of 3 have been "taken out" it is impossible for any multiple of 3 to be prime and so on for other numbers.

Christopher would also encounter considerable practical difficulties. In the diagrams his numbers do not go beyond 50. Of course he would need a much higher number than this if his attempts to identify a prime number were to be meaningful. It seems reasonable to say that he would need to go up to at least four digit numbers. To achieve this he would need to construct a large number of arrays. The consequences in terms of the amount of time and paper that would be required are massive.

This represents a contradiction. On the one hand Christopher is represented as being a brilliant mathematician and yet he is seen to use a grossly inefficient method of identifying prime numbers.

This seriously undermines one of the central tenets of the book – that a person with Asperger Syndrome can be a brilliant mathematician and this calls the whole credibility of the book into question.

It could perhaps be argued that the author has used Christopher's convoluted method of identifying prime numbers as a device to illustrate the fact that whilst he has outstanding mathematical ability, it is a consequence of his medical condition that he is prone to get locked into repetitive methods of calculation and of recording data. This would suggest that he would have had a poor examination technique in which case it is inconceivable that he would have achieved an A grade in A level mathematics at the age of 15.

This seriously undermines one of the central tenets of the book – that a person with Asperger Syndrome can be a brilliant mathematician

Of course most learners with S.E.N. do not have Christopher's outstanding mathematical ability. A consideration will now be made of resources and teaching strategies that could be used in an attempt to enable learners with learning difficulties to improve their understanding of the concept of prime numbers.

Strategies aimed at enhancing an understanding of prime numbers by students with a learning difficulty.

As a general principle within the teaching of

mathematics to students with a learning difficulty it is helpful to use a variety of different resources and to use a strategy that is heavily dependent on repetition and reinforcement through the use of a variety of different resources and activities. The following resources should be helpful:

A classroom calendar

1-100 number sheets

Numbered cards from 1-100

Calculators

Classroom calendar

The calendar should be a focal point of the classroom and consist of colourful, eye catching pictures on a theme that is of interest to a particular class such as pop stars or cats. Each month would represent a picture at the top with individual rectangles for each of the dates below. Written entries could then be made in the appropriate spaces of forthcoming events such as birthdays of members of the class or forthcoming school trips. This could then be used for topical mental maths questions such as *How many days till your birthday? Or How many weeks till the end of term?*

Within the theme of prime numbers, the question could be *Is today's date prime?* Supposing the date is 28.04.2016 the following strategy could be used. Ask the class to find the sum of the digits. When an answer of 23 is given the respondent can be praised and this answer confirmed as correct. The class can then be encouraged to check if each prime number up to 19 is a factor of 19 or not:

2 As 19 is not an even number 2 is not a factor.

3 The sum of all of the digits is 10. 3 is not a factor of 10 and so it cannot be a factor of 19

5 As the final digit is not 0 or 5 then 5 is not a factor.

7 Divide 19 by 7 and a remainder will be obtained so 7 is not a factor.

11 As 2 x 11 =22, 11 is not a factor

13 and 17 clearly are not factors of 19.

19 19 is a factor as 1 x 19 =19.

It can then be explained to the class that it has been demonstrated that 19 is prime as the only factors are 1 and 19.

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Each member of the class could then be asked to calculate if their birthday is prime or not and appropriate support should be provided.

1-100 Number Sheets

Each pupil is provided with a 1-100 sheet and coloured pencils. The first task is to colour in blue all of the even numbers, except 2. All of the multiples of 3(except 3 itself), should then be coloured in red. These numbers could be found by starting on 6 and then successively counting on three squares. Alternatively the constant button of a calculator could be used by pressing 3 then + then 3 and then repeatedly press =. A similar method could be used to identify multiples of 5 and of 7, except 5 and 7 themselves. Multiples of 5

can be coloured in green and multiples of 7 can be yellow. Of course, some squares will contain more than one colour and this could generate a helpful class discussion about factors. The discussion could then move onto a consideration of the reason why some numbers have not been coloured in. An understanding that these numbers are prime could then be encouraged.

Numbered cards 1-100

A game that can be played is called Prime. This is a game for two players that is similar to Snap. All of the cards are distributed equally to the players. Each player then takes turns to lay a card face up. If a prime number is correctly identified the player who shouts prime first picks up all of the cards on the table. If the shout is incorrect then the other player picks up the cards. The game finishes when one player has no cards left.

An understanding that these numbers are prime could then be encouraged.

Calculators

A variety of teaching strategies can be used with a jumbo calculator. Reinforcement of multiples can be used as follows. The calculator should be positioned such that all of the class or group could see it. The task could then be to find the multiples of a particular number. Take the example of 3. The teacher will slowly press the keys 3 +3. The class will verbally give their answer and then the equals button can be pressed to show if they are correct or not. This procedure can be slowly repeated with use of the constant button to find successive multiples of 3.

Once the class are familiar with this activity then the game Down the Pit can be played. The numbers 1-20 need to be written on a flip chart. Then three of the numbers at random should be circled. The class are then asked:

Tell me any number that will not land on any of the target numbers.

A number will then be suggested. The teacher then positions the jumbo calculator so that all of the class can see it. With the use of the constant button the teacher slowly enters the number and makes the additions. If a target number is obtained the pupil who suggested it goes down the pit. If all of the target numbers are avoided then the pupil does not go down the pit and is praised.

This activity can be linked to the theme of prime numbers by making all of the target numbers prime. Useful discussion can then ensue to reinforce the concept of prime numbers.

Mark Pepper

Note: I was introduced to the game *Down The Pit* on a mathematics training course run by I.L.E.A. in 1982

References

Haddon,M (2003) *The Curious Incident of the Dog in the Night-Time* Vintage

Peacey N (2004) Review in *Equals* Vol 10 No 2

Maths talk

This edition of Maths Talk features **Nichola**, a hospital teacher who left mainstream primary teaching 20 years ago.

Could you describe what it means to be a hospital teacher?

I teach children, from any Key Stage, who have long-term illnesses. We teach one-to-one, often at their bedside. The biggest difference is that the children are ill so I am always aware of their physical and emotional state at the start of my time with them. Often their parents and other family members are present as I teach. It's a balancing act judging when a child is ready to learn and when it's best to work more on developing a working relationship.

Can you describe some key moments that have shaped you as a teacher?

In one of my schools I taught tow boys from Pakistan who had never seen snow before. We took them outside so they could catch the snowflakes. That really brought home to me the importance of experiential learning and the need to be opportunistic in how you respond to the needs of your pupils. Now most of my teaching is opportunistic and I just go with the flow. I feel comfortable with this because of my experience I can gently steer the learning down more productive lines.

Working with children with brain tumors has had a huge influence on me. It can be challenging as they regress and so I have to try and help them and their parents manage the decline without highlighting it. For example if a child is loosing their sight and loves working on i-pads then I search for a way to keep using but also to gradually replace it with something more closely matched to their abilities.

Mixed ability or setting?

It depends upon the subject perhaps sets can be more helpful for more academic pupils. I haven't taught groups for so long that I do not have a sense of what work would for me back in the classroom.

You trained at Charlotte Mason College, in Ambleside. What impact did your four year B.Ed. training have upon you?

It was the child-centered ethos , espoused by the lecturers such as Mick Waters and Richard Dunn, that has stayed with me. The principles I use today are the same – allowing the children to play a central role in their own learning. I was also introduced to High Scope and the plan, do, review process. Again these same principles underpin my good practice today. I would love the chance to become involve din the Forest School movement but that is not possible with the pupils I now teach.

My first year of teaching was the first year of the National Curriculum and so I was not trained to follow the 'curriculum' and so it does not come naturally. If you look at Nursery education and their pedagogy I feel we would all be so much better off if that was the pattern all through school, including A level; we would have purposeful, independent and happy learners.

How do you approach planning now you mainly work one-to-one?

I need to get to know the child first by giving them a range of experiences, games and stories. Only then do I decide and start my planning, school often send their plans but we always tailor what we use to meet the needs of the child. Regardless of my written plans I always try to follow the lead of the child. This has enabled me to discover some real gaps in their knowledge and at times they will share some of the interesting ideas they have.

What advice would you give to anyone who wishes to support the lower ability pupils within their classroom?

Find out what they are interested in and use that. They are often good at this and feeling positive about their work really helps in a one-to-one situation. I do not expect linear progress and feel that naturally children need lots of repetition, as that is the way young children learn. This can be hard because the parents often observe and wonder why they are doing the same thing over again. I try to make learning purposeful and fun as I find now that much of what children do in school can be pretty boring. I will try to use other, more creative tools, rather than simply writing. I always allow them to be creative and to produce something they can be proud of and then encourage them to share what they have done with those around them i.e. nurses, Doctors, parents and their home school.

The teaching and learning of mathematics to pupils with a visual impairment

Mark Pepper **has a passion for inclusion, and in the first of a series of articles he outlines the difficulties facing VI students and shares a few strategies their teachers can use to support their learning.**

One of the most significant changes in educational policy in this country in the past twenty years or so has involved a sharp increase in the number of pupils with various special educational needs (SEN) being included in mainstream education. One such group are pupils with a visual impairment (VI). This change has resulted in a reduction in the number of special schools and a dramatic increase in the number of pupils with a VI being absorbed into mainstream classes or into VI units within a mainstream school. Hence a mainstream classroom teacher could have a pupil with a VI included in their class.

The purpose of this article is to provide suggestions for appropriate provision to be made to meet the needs of pupils with a VI. This will include strategies aimed at minimising the barriers to learning as far as possible. The initial focus will be on the general interaction of pupils with a VI with the environment in their day to day lives and then a more detailed consideration will be made of their access to the curriculum generally with a particular emphasis on the learning of mathematics.

Interaction with the environment

There can be considerable difficulties for pupils with a VI (especially those who are totally unsighted) in interpreting the environment. This was forcibly impressed upon me in the course of a verbal mathematical assessment I undertook with a Year 11 student who I will call John. Though John has been totally blind from birth he copes very well in his everyday life.

One of the questions was:

Paul needs to attach some numbers to his front door. He has the numbers 1, 2 and 3. What are the possible numbers of his house?

John considered this and then correctly named all of the single and double digit possibilities. As I was surprised that he did not suggest any 3 digit numbers I asked him if he could think of any other answers. He responded by saying that he knew there couldn't be any 3 digit numbers. When I asked for his reasons he replied that "no road could be that long."

Upon further discussion it became evident that John thought that all roads were short. As he had never seen a road this was a reasonable assumption. He showed considerable surprise when I explained to him that most roads consisted of hundreds of houses.

John thought that all roads were short. As he had never seen a road this was a reasonable assumption.

He showed considerable surprise when I explained to him that most roads consisted of hundreds of houses.

Hence John had not made a mathematical error despite the fact that he didn't provide all of the possible door numbers. If less time had been available and John's answer had been accepted without discussion he would have been incorrectly assessed as having a weakness with the use of 3 digit numbers.

The use of touch

For the pupil with a VI there is a heavy dependence on the use of touch to compensate for the loss of sight. Hence skills have to be developed to facilitate the ability of the pupil to be able to interpret a brailled text by carefully feeling the raised lettering of the braille. Similarly tactile diagrams would need to be accessed through the medium of touch.

Advances in Technology

Recent advances in technology have resulted in greatly improved learning resources for learners with a VI. Perhaps the first of these advances was created with the introduction of software, such as Jaws and Super Nova, that consisted of magnification and screen readers. This meant that an automated voice, invariably a male voice with a strong American accent, would read aloud the text that appeared on the computer screen. In recent years associated conferencing software technology such as Display Note and Team Viewer have been developed to such a sophisticated degree

that an electronic link can be made between the learner's iPad and both the teacher's computer and the interactive whiteboard. This innovation enables a learner to independently access and enlarge the image or text on the whiteboard or the teacher's computer. The iPad can also be used to magnify texts and diagrams from books or worksheets to an appropriate size. An impressive resource for braille users consists of the braillenote. This is a device that is smaller than an iPad. It has a brailled keyboard and the brailled output can be converted into speech. A connection with the internet can also be made and other devices such as a talking calculator can also be installed on it. Easy converter software is also available and this device can convert print into speech, large print or braille. Another recent advance has involved the introduction of portable CCTVs. Formerly a CCTV would be statically located in the classroom for use by learners with a VI. The portable CCTV enables the learners to take it with them as they move around the school. Some of them even have an inbuilt high definition distance camera in order to view the whiteboard, learning walls and the teacher demonstrations.

An impressive resource for braille users consists of the braillenote.

Another recent advance has involved the introduction of portable CCTVs.

Making the curriculum as accessible as possible

A key requirement for a class teacher who has a learner with a VI in her/his class is to make the curriculum as accessible as possible to that child. Extremely valuable support can be obtained by contacting the L.E.A. Visual Impairment Service. Support can then be provided on a wide range of issues that could include adaptation to the classroom environment, mobility, one to one support, resources and the adaptation of resources.

Adaptations within the classroom

There are two main categories of learners who have a VI. One of these consists of learners who have sufficient sight that they can access enlarged print whilst the other category consists of learners with very limited sight who use braille. The former will be referred to as print users whilst the latter will be referred to as braille users.

Print users

If the lighting is considered to be inadequate then a light can be provided at the learner's desk .

In some cases a sloping desk can be appropriate.

The use of CCTV can be beneficial though a portable CCTV would be more efficient.

It can be helpful to make appropriate magnifiers available.

The learner should be positioned at an appropriate distance from the whiteboard to be able to access the information on it.

Braiile users

Additional lighting can be helpful for a learner with some sight.

In some cases a sloping desk can be appropriate.

Mobility

Braille users

It is essential that the learner becomes confident in accessing different parts of the school. The VI service can provide training such that the learner memorises the routes to other parts of the school and within the classroom is able to independently locate resources.

One to one support

Print users

Individual support can be provided by a VI tutor but is more commonly provided by a teaching assistant attached to the school and this could well only be available on a part time basis. The support can involve verbal advice on a text or diagram that the learner has difficulty in seeing in detail. Written work can be recorded for the learner with the use of a thick black pen with a contrasting background such as white. In some instances an individual learner may show a preference for a different background colour.

Braille users

The individual support for a braille user can vary considerably in accordance with the different needs of learners. If the learner is not an accomplished braillist then the support could focus primarily on the brailling of information. It could also be the case that considerable support would be required in the interpretation of tactile diagrams.

In instances where the learner is an accomplished braillist then verbal descriptions of objects or diagrams would be appropriate.

The individual support for a braille user can vary considerably in accordance with the different needs of learners.

Adaptation of materials

Print users

Resources such as worksheets should be produced in enlarged form to a size that is in accordance with the learner's visual assessment . A visual assessment can be undertaken by the VI Service.

Diagrams should consist of thick black lines on an appropriately contrasting background.

A laptop computer should be made available.

A large key calculator with a large display should be made available.

Braille users

Written materials should be in a brailled format and diagrams should be in tactile form.

Equipment such as rulers should be in tactile form.

IT Resources

Print users

An iPad as described in Advances in Technology section should be provided.

A calculator with large buttons and a large display should be made available.

Written materials should be in a brailled format and diagrams should be in tactile form.

Braille users

A laptop computer together with a software programme such as Jaws or Super Nova should be provided.

Audio tapes would be a helpful resource.

A talking calculator should be made available.

Funding

The effects of current Government policies and the present economic climate place great restraints on school budgets. Whilst the above recommendations represent the resources that would ideally be required some schools may be unable or unwilling to finance these resources, especially the IT hardware. In such cases it is to be hoped that at least some of these needs would be met.

With reference to payment for services from the LEA VI Service the usual practice is for no charge to be made to schools as they would already have made a contribution to the LEA for generic needs. There are, however, variations between different LEAs regarding academies. Some LEAs currently do not charge academies if the child who is receiving support resides in the LEA. Other LEAs do charge academies on the basis that they would not have made any contribution to LEA funding.

Integration

One of the main purposes of educating learners with a VI within the mainstream system is to encourage a policy of inclusion. Hence learners from a variety of backgrounds and with different needs can socialise amicably. The fact that this can work efficiently was demonstrated when I visited a mainstream primary class that included a girl with a VI, who I will call Natalie. A maths problem had been written on a flip chart and the teacher asked for a volunteer to come and write the answer. Natalie volunteered and as she approached the flip chart one of her classmates said:

"She can do it. Its only her eyes that don't work well."

"She can do it. Its only her eyes that don't work well."

That comment effectively encapsulated the co-operative spirit that existed in the class.

Mark Pepper

Mark Pepper was Head of Mathematics at Linden Lodge School for blind and visually impaired pupils from 1996-2006

I would like to extend my thanks to Tim Richmond, VI Specialist Teacher at Wandsworth Vision Support Service, who has provided helpful advice on current issues within the education of learners with a VI.

Mikos De Symmetria: a special approach to Trigonometry

We were approached by a young mathematician from India, Sameer Sharma, who sent a really interesting article on Trigonometry. We felt that we could do little else but showcase the thinking he has been doing and if you would like to share any thoughts with him please e-mail the Editor who will pass them on.

I am 14 years old and in grade 1X. My favorite subjects are Mathematics and Science.

In my opinion mathematics is something from which all the major subjects are related for example, physics related with arithmetic, construction work (buildings etc.) is related with geometry and many more……

In future, my aim is to become a Research Scientist at ISRO. And I will make Research in Mathematics as my passion.

Name: Mikos De Symmetria

The name Mikos de Symmetria has been derived from the Greek words "Mikos" Meaning length and "Symmetria" meaning measurement. Which means Length Measurement through Scale.

Introduction

As we all know that Mathematics plays a very important role in our life. By Trigonometry we can find the length of any building, object etc. using the ratios of angles and their sides.

Being very impressive in nature, it also has many drawbacks some of them are as follows:

1. Its Instrumentation is very complicated and also very expensive.
2. Trigonometry works only when the object is perpendicular to the surface.
3. It has around 2160 Ratios which are difficult to learn and remember.

In order to overcome the above mentioned drawbacks, I have carried out another method named "**Mikos de Symmetria**" also its instrumentation is very simple to make and use.

Scale:

Being very simple in nature. It is the one of the most powerful mathematical tool since it has the ability to convert in any other mathematical instrument such as protractor, compasses etc. the only thing we need is our **IMAGINATION**. In my opinion it is the one of the most powerful tool ever made which I have seen until now.

Instrumentation

Materials required:

1. A flat board
2. A clean Scale (in centimeters)
3. A base Stand of certain height.
4. Moveable rotator
5. Magnifying glass (optional, just for more accurate measurements.)

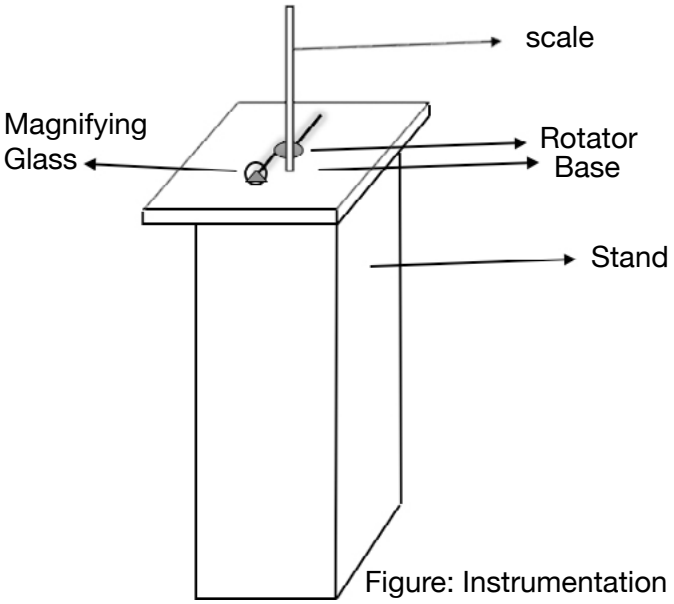


Figure: Instrumentation

In order to make the apparatus, take the base and stick the board on it. And on the board, stick the scale headed by moveable rotator.

Main concept

The main concept behind this research is:

"THE FURTHER AWAY THE OBJECT IS, THE SMALLER IT SEEMS TO BE AND VICE VERSA"

Experiments

I have done various experiments in order to find the relationship between scalar height (i.e. The height which is measured by scale) and the actual height. They are done in the following way.

In doing the experiments we have to find the scalar lengths from a place. Let's see some illustrations: (see Figure 2 below)

OBSERVATION – I

On the basis of illustrations, I have made the table (Table 1) measuring various objects. These include the following objects:

1. Bottle cap
2. Bottle
3. Watch box
4. Flash drive
5. Cardboard box

Measurements Taken:

1. At 30 Cm away.

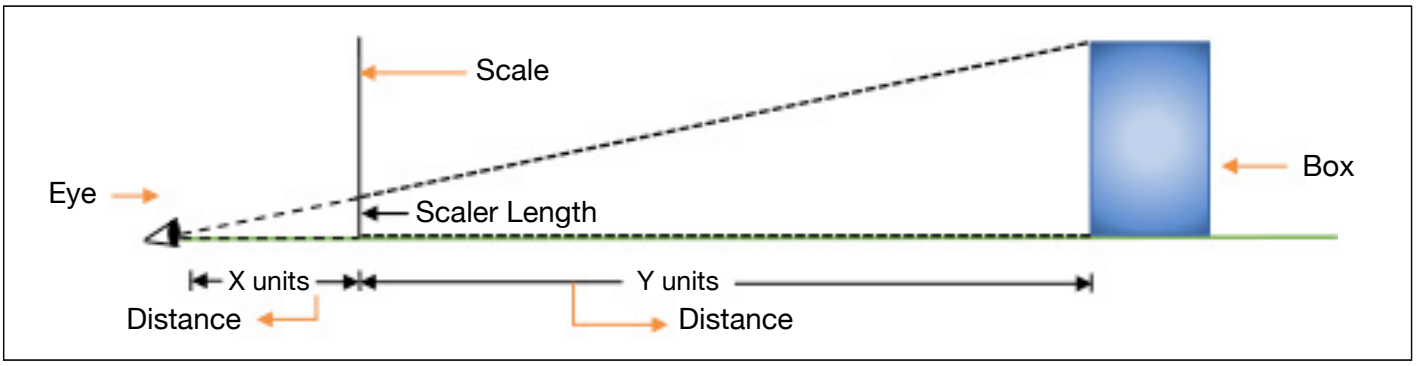


Figure 2

Objects	Actual Length	At 30cm Observation - I	At 15cm Observation - II	Length Increased
Bottle cap	2.6 cm	1.4 cm	1.8 cm	0.4 cm
Bottle	9.0 cm	4.8 cm	6.2 cm	1.4 cm
Watch Box	6.3 cm	3.0 cm	4.1 cm	1.1 cm
Flash Drive	2.6 cm	1.4 cm	1.8 cm	0.4 cm
Box	3.0 cm	1.5 cm	2.0 cm	0.5 cm

Table 1

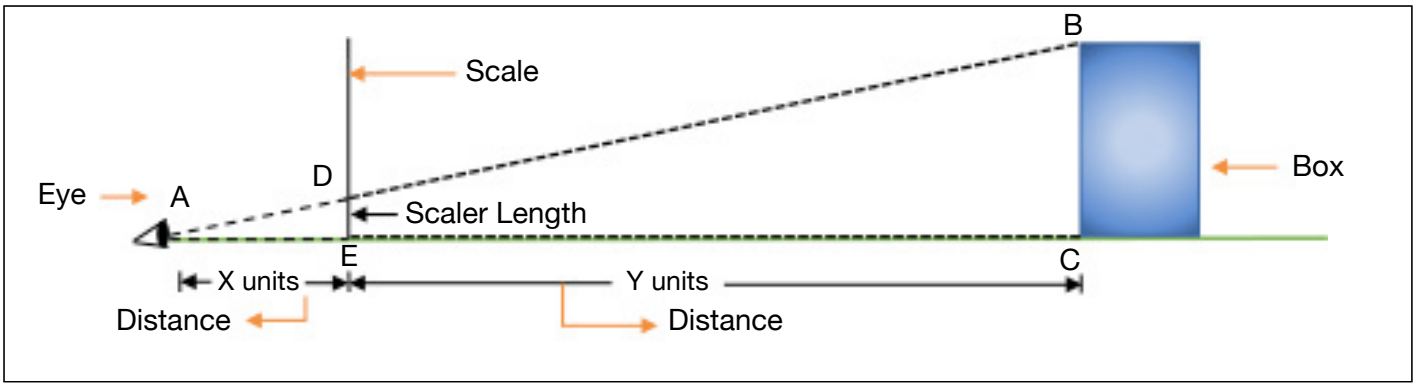


Figure 3

2. At. 15 Cm away.

Distance between eye and scale is 29 cm.

Derivation of the formula

Let the object of height 'h' is placed at a distance of k units away from scale and distance between the scale and the eye be y units.

Let us represent this illustratively: (see Figure 3 above)

From the above illustration we see that two triangles are formed (See Figure) i.e. Δ ABC and Δ ADE

Now in Δ ABC and Δ ADE

∠ BCA = ∠ DEA

∠ BAC = ∠ DAE

Therefore, by AA similarity Criterion,

Δ ABC is similar to Δ ADE, since they will form same ratio,

Therefore, $\frac{AE}{EC} = \frac{DE}{BC}$

And in the above equation, we know AE, EC, DE.

By putting the values of three variables, we will get the formula as:

$$\text{Actual length (BC)} = \frac{(EC \times DE)}{AE}$$

Hence Derived!

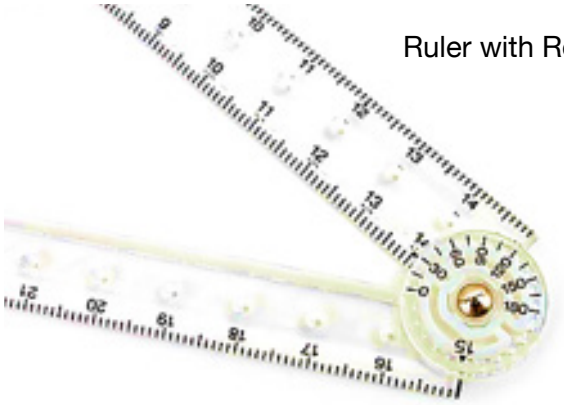
Importance of this research

It has many significant factors:

1. It is easier than trigonometry.
2. There is no effect of angles on it.
3. It can even find the length of one which is not perpendicular to its surface.
4. It can find the diameter, surface area, volume of moon and even stars!!!!

Precautions while carrying out experiments:

1. Head should be kept in same position means there should be no shift in eyes while observing the object.
2. Scale should be neat and clean means the markings should be clearly visible on it.



Ruler with Rotator

Magnifying Glass

Magnifying Glass

Illustrations

Suppose we want to find the length of building, then the correct way of measurement will be: (see Figure 4 below)

The illustration below is the correct way of measuring objects.

Special cases:

1. Slant case:

For the object which are not perpendicular to the ground, it will be difficult to find their lengths by trigonometry, but their lengths can be easily be found by MIKOS DE SYMMETRIA. For more details, let us see the illustration….

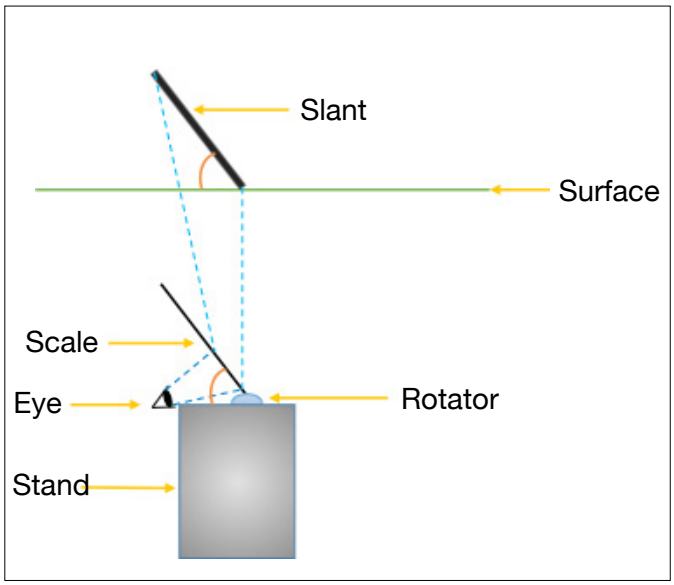


Figure 5: Measuring objects with slanted heights

2. Celestial case: case of moon

We can also find the measure of the celestial bodies using this formula which cannot be found using Trigonometry. Let us understand it through Illustrations. As we all know that moon revolves round the earth on an elliptical orbit. That means there are two points which are the farthest point and the nearest point. The two points are known as:

Closest Point (PERIGEE) = 225,623 Miles

Farthest Points(APOGEE) = 252,088 Miles

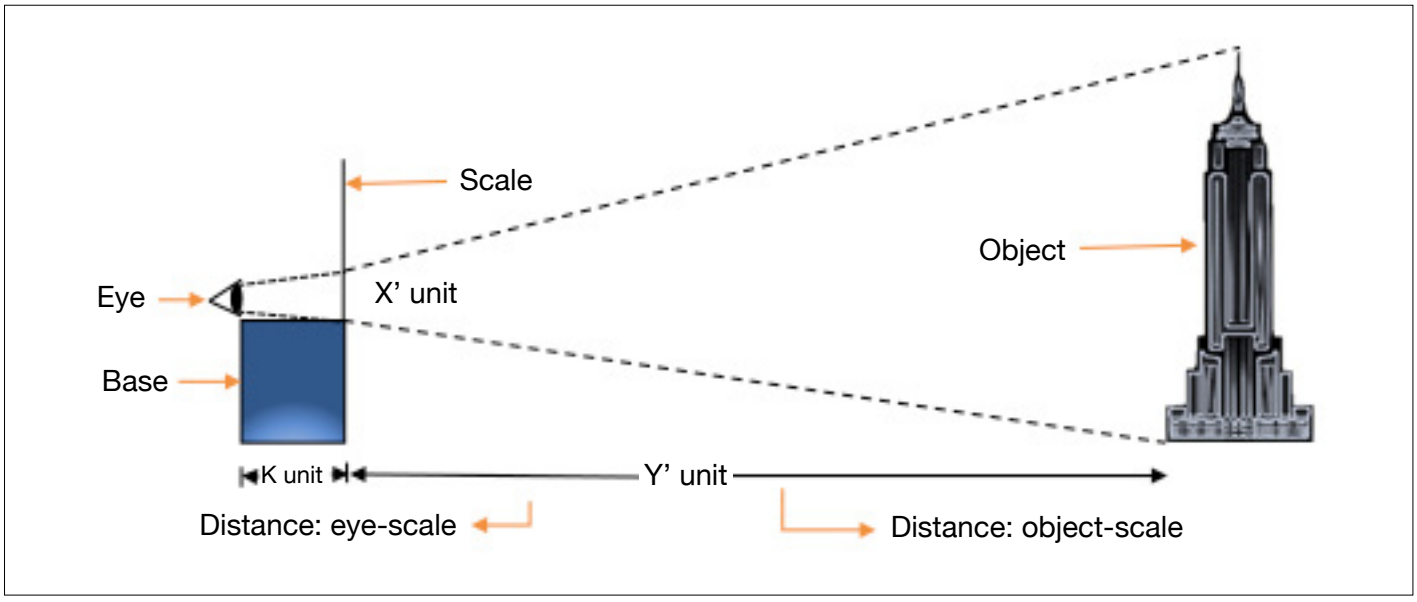


Figure 4

These two points can be identified using the phrases of the moon as the quarter part is the PERIGEE and the full moon or the new moon is the APOGEE. Let us understand it through Illustrations…….

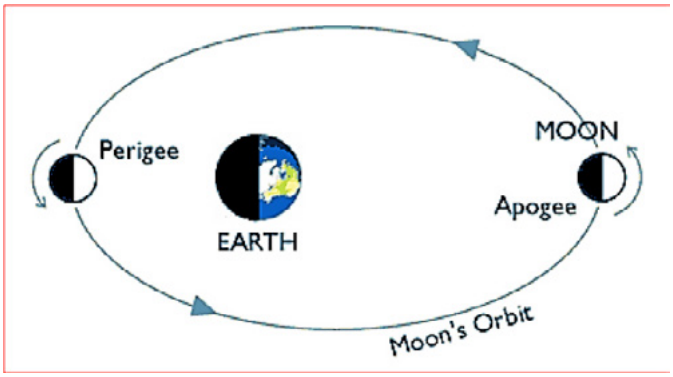


Figure 6: Image showing apogee and perigee

Conditions for this method:

1. We should know the distance between object and scale no matter how we measure the distance. we can even measure the distance with our foot.

Epilogue

At last I want to conclude that by using this method we can find the length of any object using the relationship between scale-object distance and scale-eye distance making it easier to use than trigonometry and the formula used is very simple to remember than trigonometric ratios. So I will consider it as easier method of trigonometry.

Objects to think with. Papert (1980)

In this piece **Mary Clarke** reflects upon the importance of the work of Papert and how his ideas might help classroom teachers today.

Making the Most of Manipulatives

One of the most effective ways to help children really understand maths is to use a wide variety of manipulatives. Manipulative materials are any objects that pupils can touch move or arrange to model a mathematical idea or concept. They help children to explore the patterns and relationships in maths in a concrete way. However, their use is nothing new. Piaget in 1951 recommended manipulatives as a way of embodying mathematical concepts. Gattegno and Cuisenaire developed Cuisenaire rods in 1954 and Dienes developed his base ten materials in 1969 as a way of helping children to grasp fundamental mathematical concepts.

In the 1960s Bruner put forward the idea that children need to go through three stages, concrete-pictorial-abstract, in order to fully understand a mathematical concept.

Briefly his model can be described like this:

Concrete. At the concrete level manipulatives are used to explore and solve problems.

Pictorial. At the pictorial level pictures, drawings, diagrams, charts, and graphs are used as visual representations of the concrete manipulatives.

Abstract. At the abstract level symbolic representations are used to represent and solve the problem.

This is the basis for some of the most successful methods of teaching maths, including the Singapore

approach and the approach used by researchers such as Professor Sharma in supporting children with dyscalculia.

Stein and Bovalino (2001) stated
"Manipulatives can be important tools in helping students to think and reason in more meaningful ways. By giving students concrete ways to compare and operate on quantities, such manipulatives as pattern blocks, tiles, and cubes can contribute to the development of well-grounded, interconnected understandings of mathematical ideas."

So it is clear that manipulatives are an essential tool for teaching mathematical concepts. They help children to understand the maths and develop visualisation skills which are so important for making sense of maths. However, many practitioners are unclear of how to get the most out of the manipulatives they have in their classrooms and many children simply use them as a crutch or tool to support a particular mathematical procedure.

pattern blocks, tiles, and cubes can contribute to the development of well-grounded, interconnected understandings of mathematical ideas

Ofsted's 2012 report 'Made to Measure' suggests that although manipulatives are used in some primary schools to support teaching and learning they are not used as effectively or as widely as they might be.
This means that the children are not getting the depth of understanding that they could be achieving through a more consistent and effective use of manipulatives. Using a wide variety of manipulatives can help children to develop a range of skills and concepts including:

- Sorting
- ordering
- spotting patterns
- recognising geometric shapes
- understanding base-ten and place value
- the four mathematical operations— addition, subtraction, multiplication, division
- exploring and describing spatial relationships
- developing and using spatial memory
- problem-solving
- representing mathematical ideas in a variety of ways
- making connections between different concepts
- communicating mathematical ideas effectively

A key point is to make sure that the children have a wide variety of manipulatives available, for as long as they need them. Using manipulatives over long periods of time is much more beneficial than occasional short term use.

Children who habitually use manipulatives make gains in the following skills

- using mathematical language to explain their thinking
- relating real-world situations to abstract maths
- working collaboratively
- thinking more flexibly to find different ways to solve problems
- developing metacognition
- working independently
- being more resilient and persevering with problems

One particular problems that children have when

learning maths is that they see each area of maths as separate and unconnected. For example, division can be taught as repeated subtraction but children may also come across fractions in terms of shading segments of a cake and they are unable to make the link between the two concepts. This compartmentalising of maths can be very detrimental to children who are struggling and have poor number sense. One way to overcome this is to highlight patterns and connections between areas of maths by using continuous manipulatives such as base-10 materials/Dienes and Cuisenaire rods.

Initially children will often prefer to work with discrete materials such as counters, beads or cubes

Initially children will often prefer to work with discrete materials such as counters, beads or cubes, but it is a good idea to move on from these materials so that they can move on from counting in ones. Using a variety of manipulatives will help the children to make links between areas of maths and will help them to see it as an interconnected rather than compartmentalised subject.

The use of manipulatives has been shown to support children who are struggling as well as extending more able children. It also makes for a more inclusive classroom environment and helps to reduce maths anxiety. Above all, maths is much more fun for the children if they have a variety of manipulatives at their fingertips.

So how can we best use manipulatives in the classroom?

Common pitfalls

Children using the manipulatives as crutches to follow a rote procedure rather than as a means to developing understanding.

Teachers selecting a certain type of manipulative to teach a particular concept.

Using manipulatives as an add on to a lesson or as a reward.

Using manipulatives only for children who are struggling.

One of the greatest causes of maths anxiety in the classroom comes from manipulatives being taken away too soon, leading to maths becoming abstract and meaningless.

The way forward

Free play, letting the children discover the properties of the manipulative for themselves.

Access to a wide variety of manipulatives, with children being able to choose what they want to work with.

Manipulatives readily available from Foundation stage to Key Stage 3 and preferably beyond.

One particular problems that children have when learning maths is that they see each area of maths as separate and unconnected

Encouraging children to demonstrate the idea with their chosen manipulative.

Encouraging children to generalise.

Ask the children to show you and each other different ways of solving a problem using a variety of materials.

(This article is an extract taken from ‘Making the Most of Manipulatives’ by Judy Hornigold. Due to be published by SEN Books in March 2016)

Review - Rachel Gibbons

Embedding Formative Assessment
Dylan Wiliam & Siobhan Leahy
Learning Sciences International

Although this book is written very much in the context of the American classroom, it contains a wealth of novel ideas for making effective formative assessment which will fit just as well to the classrooms of this country as American ones. Wiliam and Leahy have many years of experience teaching in schools on both sides of the Atlantic - and indeed also in leading and training teachers in the UK and the USA.

It is always difficult to make assessment really meaningful to a class: the pupils who have been successful in the work they have done are eager to press on to fresh fields rather than to look back to see what could have been improved in work already completed, whereas those whose work has proved inadequate do not necessarily want to be reminded of their failure. I have observed too many lessons "going over homework" which has been a complete waste of time for the majority of the pupils in the class.

But so much can be learnt from a study of work already completed that it is important to make some attempt at formative assessment. Formative assessment is indeed vital to effective teaching. For how else, as Wiliam and Leahy point out, can we know where to l lead our pupils next in their mathematical journeys? One solution Wiliam and Leahy suggest to tackle the difficulty of getting pupils to look back which particularly appealed to me is to write your assessments of individual pieces of work, not in pupils' exercise books, but on separate slips of paper. Then hand back a set of, say, five books with the five relevant assessments written on separate slips and ask the group of pupils to fit the assessments to the relevant pieces of work. What a valuable discussion must arise from that task: discussion based on a thorough examination of the five versions of the completed task. I wish I had thought of that – so simple yet so effective!

It is always difficult to make assessment really meaningful to a class

For any teacher examining the relationship between what she is attempting to teach and what her pupils have learnt is vital as Wiliam and Leahy remind us for students do not always learn what we teach, and we had better find out what they did learn before we try to teach them anything else - which is why, of course, these authors stress the importance of formative assessment being firmly embedded in all our teaching.

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