



NUMBERS COUNT (ECIE5002)

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PORTFOLIO – 5 ELEMENTS (4,000 WORDS)

Index

Page 2-5; Element 1, Essay: The Effect of Poor Numeracy Skills on Truancy, Exclusions and Crime.

Page 6-9; Element 2, Blog: Why Numeracy Starts at School and Shapes a Lifetime.

Page 10-12; Element 3, Information Sheet: Dienes Base-Ten Information Sheet.

Page 13; Element 4, Video: Link to Dienes Base-Ten Activity.

Page 14-16; Element 5, Evaluation: Evaluation of Dienes Base-Ten Blocks.

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Portfolio – 5 Elements (4,000 words)

Element 1 – Essay

The Effect of Poor Numeracy Skills on Truancy, Exclusions and Crime

Numeracy is a concept that goes beyond arithmetic content (Díez-Palomar et al., 2023). It's importance throughout modern societal life goes way beyond what is taught in the classroom, and yet according to recent reports, Wales is way behind its European neighbours in raising the attainment of numeracy in the classroom (Sibieta, 2024). Mathematics has been taught throughout the world for centuries in various forms such as algebra and ratio, however numeracy, which focuses on the application of maths in real life situations like at home, could prove crucial to raise living standards in everyday life (National Numeracy, 2019).

According to the Pisa report in 2022, Wales' average score for mathematics was significantly lower than the average across the OECD (The Organisation for Economic Cooperation and Development, which has 38 member countries) (Ingram et al., 2023). Interestingly, 63% of learners in Wales reported that they felt a sense of belonging in school and learners that had a strong sense of belonging in school had significantly higher maths scores than learners who did not feel this way (Ingram et al., 2023).

The effects of poor numeracy skills can be felt amongst many areas of life such as health, social, emotional and behavioural difficulties. It can be impactful when trying for employment, or working out wages, how people manage money. In worst case scenarios, poor numeracy skills are linked to an increased likelihood of school exclusion, truancy, and crime (Schleicher, 2014). To have good numeracy skills means to have a strong understanding of maths and its application in real life situations. It's about reasoning and problem solving as much as being able to calculate the numbers themselves (Haley, 2022).

School exclusions, truancy and crime may seem a rather disproportionate link to poor numeracy skills, however, a survey conducted by Ipsos Mori showed that 47% of people would be embarrassed to admit they were no good at maths (www.kcl.ac.uk, 2019). A fear of failure or lack of understanding could hinder a students attendance causing them to fall further behind academically. Emotional-based school anxiety (EBSA) can be linked to Bronfenbrenner's Ecological Systems Theory (1979), particularly when looking at the Macrosystem which encompasses the cultural and societal facts and the

pressure to achieve academically (Fairclough, 2024). By being unable to understand simple mathematical concepts, it has potential to lead to an overwhelming sense of frustration and demoralisation, as advanced mathematical concepts follow (Jarvis, 2003). The overwhelming feelings of failure enhance poor attendance creating a downward spiral and mental blockage when numeracy is involved (Bera.ac.uk, 2024).

“School exclusion is both a symptom and a cause of wider social inequalities” (King, 2025). There are many reasons behind school exclusions usually stemming from additional learning needs, pupils from poor socioeconomic backgrounds and lack of school belonging however, it is significantly higher amongst secondary aged children than any other school age (Gov.wales, 2026). Without the foundational skills in mathematics taught in primary schools, the engagement in maths lessons during secondary schools becomes overwhelming. The behaviour that causes an exclusion to be made is largely due to unmet needs and lack of support provided in schools (Wiserd.ac.uk, 2022). Poor maths scores and achievements in primary schools have significant consequences in teen years and adulthood and failing to resolve these issues at an early age can lead to greater unemployment, lower wages, school exclusions, substance misuse and criminal activity (Field et al., 2019).

School truancy and exclusions have been thought to be connected to crime for many years, and a study by the Office of National Statistics further enhances that belief. Young people who had been detained in custody had poor educational backgrounds with only 36.9% achieving attainment in maths and English by the end of key stage 2, with a comparable 53% of other children receiving non-custodial sentences or cautions (Office for National Statistics, 2022). To further look at the correlation between low maths attainment and crime, 25% of young people detained in custody have the maths ability below the average 7-year-old child and 65% of adults remanded in custody have the numeracy capability at or below the expected level of an 11-year-old child (Schleicher, 2014). Crime has a significant impact on the UK economy as shown in a report for the year 2015/2016. It is estimated that the total cost for the UK economy in England and Wales is an incredulous £50bn on crimes against individual and £9bn for crimes against businesses (Heeks et al., 2018).

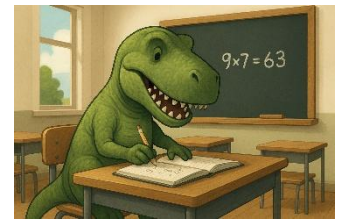
The numbers are evident in proving that there is a strong link between low numeracy attainment within school truancy, school exclusion and crime statistics. Numeracy is a required skill throughout life regardless of a person's chosen profession. Whether that person is a stay-at-home mum needing numeracy skills to calculate bills, or an accountant needing a much more mature level of numeracy ability, there is still that baseline requirement to achieve numeracy skills to navigate life effectively. It has been shown that early mathematic attainment and thinking is foundational for cognitive development and a successful academic career (Meylani, 2024). In the Welsh Government's national mathematics and numeracy plan it states that it's their mission to achieve high standards of numeracy skills for all, achieving this through their new curriculum plan. By supporting schools to develop their understanding of purposeful mathematics and creating opportunities to experience authentic mathematical

application in real-life situations as part of their learning (Welsh Government, 2023). Improving numeracy skills at an early age through fun engaging ways could be the key to preventing a poor life outcome and studies have shown that by raising numeracy attainment can have a profound effect on a person's life choices.

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Element 2 – Blog

Why Numeracy Starts at School and Shapes a Lifetime.

The evolution of taught numeracy skills has been a relatively rapid process in schools and has significantly changed since I first stepped foot into a classroom at the tender age of 4 years old some 40 plus years ago!

Long gone are the days of chanting multiplication tables, desperately trying to memorise them for fear that a blackboard rubber would come hurtling towards your head or working through a grubby, over-thumbed textbook, writing reams of equations.

So, how have things changed over the years and how do we ensure that we are providing an engaging, inclusive, pedagogical approach when teaching numeracy skills?

Enter Cockcroft...

In 1982 a report was published that would forever shape the future of mathematics, The Cockcroft Report. It highlighted the importance of mathematics, how it is taught in UK schools and the impact of good maths skills within other subjects and throughout life. He quoted “*mathematics can be used as a powerful means of communication - to represent, to explain and to predict*” (education-uk.org, n.d.), this very statement encapsulates the importance of mathematical knowledge throughout life.

What can schools do to encourage good numeracy skills?

Much like numeracy skills is not only applicable to the classroom, schools should be integrating numeracy throughout the whole curriculum in a fun, engaging, purposeful way. The Curriculum for Wales Mathematics and Numeracy Plan 2023 explicitly states that numeracy should be taught as a mandatory, cross curricular skill, meaning that every subject, not just maths classes, has a role in developing learners’ numeracy skills (Welsh Government, 2023). It is crucial that educators make lessons fun and engaging to capture and engage developing minds but how can we ensure that such an important life skill is being retained?

Concrete Pictorial Abstract

The CPA approach stems from Jerome Bruner’s Representational Modes of learning (1966). The **enactive** mode states that knowledge is gained through action-based learning (Concrete), the **iconic** mode states that knowledge is gained through image-based learning (pictorial) and finally the **symbolic** mode states that knowledge is gained through language-based learning (abstract) (McLeod, 2024). This is pinnacle in teaching essential skills in education particularly numeracy skills as students of all ages can gain those skills following the CPA approach drawing on real-life experiences to “introduce, explore and consolidate mathematical concepts” (hwb.gov.wales, 2019).



Learning such crucial numeracy skills can be taught using simple concepts such as loose parts which are a cheap way of introducing a hands-on approach around the classroom. Using pinecones to represent numbers in their simplest forms not only engages the child but promotes independent learning (and who knew you could teach algebra to a 4-year-old!). Teachers can breathe a sigh of relief as teaching such skills needn't be a costly affair as loose parts are largely free, natural and accessible, promoting a learner led, inclusive approach in the classroom.

Promote Purposeful Learning in Real-Life Concepts

So how does that look in the classroom?

- Problem-solving such as pricing menus in a roleplay cafe.
- Building towers from wooden blocks.
- Planning a party around a set budget.
- Science experiments.
- Measuring the school playground using large foam bricks.

“We want to enthuse children and young people about mathematics and numeracy” (Welsh Government, 2023)

Develop Confident, Reflective Practitioners.

It's all well and good focusing practice on our young people but education starts at the top and works down. Teachers and practitioners should be mindful of their teaching practices to model how we expect our students to learn! Professional learning and development will give practitioners confidence to teach numeracy across the curriculum and schools should invest time in ensuring the ongoing development of teaching professionals (Welsh Government, 2023)

School level actions:

- **School workshops that focus on numeracy progression and assessment.**
- **Planning time to allow for integration of numeracy into other subjects.**
- **Peer observations and sharing of good practices.**
- **Using national resources and professional learning programmes** (Welsh Government, 2023)

A teacher or practitioners' knowledge and understanding of how to effectively represent a variety of numeracy concepts in an inclusive and accessible way underpins pedagogical practice (GOV.WALES, 2012).





Assess, Assess, Assess!

Now, when I say assess, I don't necessarily mean test! No student wants to sit through endless tests just to see whether they have understood a mathematical concept. The mere mention of test can send some students into panic mode, their brain turns to jelly, and they sob inconsolably about not understanding concepts they have not yet learnt. Assessment can take place in a roleplay area by means of an observation, through pupils teaching their peers how to work out something or by asking students to demonstrate their understanding using a variety of resources. It doesn't have to be a formal test or what's recorded in a book! Under the new Curriculum for Wales, personalised formative assessments in numeracy help give an insight into student's numeracy skills and their next steps required to further develop their skills. This helps support students rather than focusing solely on summative outcomes. This data can be shared with parents/carers of pupils to help give parents an understanding of where their child is developmentally (hwb.gov.wales, n.d.).



Finally, numeracy is mathematics applied in real world situations (Welsh Government, 2020). John Dewey (an influential philosopher, 1859-1952) argued that learning is most meaningful when connected to lived experiences and problems that matter to learners. The development of students actively participating in their own learning process was one of Dewey's fundamental philosophical approaches (Teachers Institute, 2024). For pupils to learn effectively it has to be purposeful, relevant and child led (Zosh et al., 2022). Mathematics and numeracy no longer has to be taught at a desk in a monotonous way as there are far more engaging ways to ensure child participation. I would much rather teach outside counting conkers rather than classroom counters and in my experience my pupils would agree that I am far more effective when I enjoy what I am teaching. Keeping education fun and engaging is by far the best way to promote positive attitudes to learning, ensuring our pupils have the best possible learning outcome.

“If we teach today's students as we taught yesterday's, we rob them of tomorrow”
John Dewey (Anon, 2019)

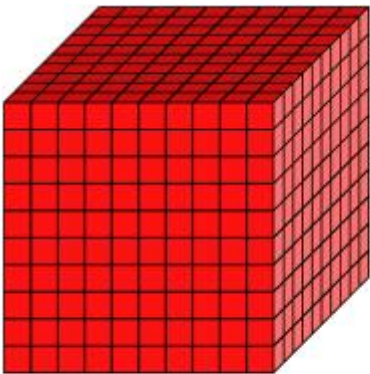
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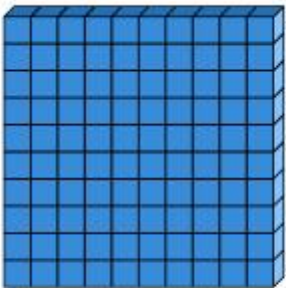
Element 3 – Information Sheet

Dienes Base-Ten Information Sheet

Dienes Base-Ten blocks are
manipulatives that help both young
and old alike to represent and
understand numbers and place value
(Marlow, 2023).



1000



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(Marlow, 2023).

Dienes Blocks also known as Base-Ten Blocks are named after the pioneering mathematician, Zoltan Dienes. Dienes was unique in his theories and believed maths could be taught at any age or ability through the medium of dance, songs, stories, games and manipulatives (Anon, n.d.).

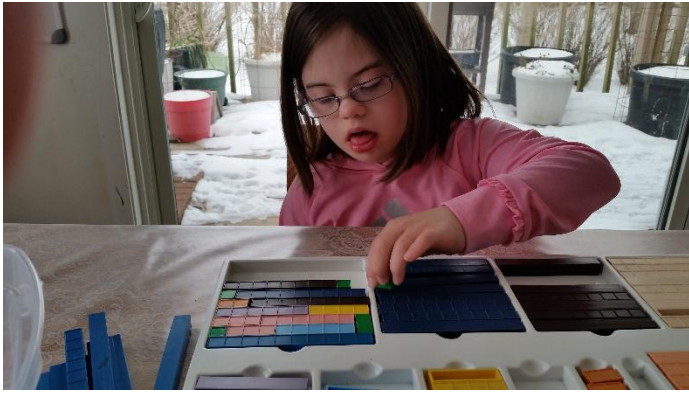
Dienes Blocks are a great way to visualise and teach place value, column addition, subtraction, exchanging, multiplication and division – the possibilities are endless!

Dienes Blocks come as single cubes (ones), ten columns (tens), hundred squares (hundreds) and thousand cubes (thousands). They are proportionally correct, allowing learners to see the correlation between single cubes, tens, hundreds and thousands (Whiteroseeducation.com, 2024).



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(Primary ICT, n.d.)



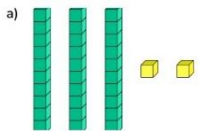
(Post, 2016)

“Practitioners should consider the use of appropriate manipulatives to help learners engage with mathematical concepts from more than one perspective.” (Welsh Government, 2022)



Concrete

(TTS, 2026)



Pictorial

(Marlow, 2023)



Abstract

“Using a CPA (Concrete, Pictorial, Abstract) approach can help pupils understand and embed abstract mathematical concepts.” (Learn Together, n.d.)

What make Dienes Base-Tens so inclusive?

Much like Zoltan Dienes embodied knowledge are focused around hands on experiences (Anon, n.d.), inclusive practice embodies strategies that promote equality, equity and inclusion (Pradhan, 2025).

Dienes Base-Ten blocks are the perfect manipulative to help learners visualise numbers, represent place value and work out equations promoting an inclusive, accessible practice in the classroom.

Break down barriers in the classroom by using visual representation and manipulatives. This enhances and supports language, promotes independence and scaffolds ideas (Ochugboju and Díez-Palomar, 2025).

Not only are Dienes Base-Ten blocks a great way to teach students but also a great way for students to show their understanding of numbers without a textbook in sight! (Marlow, 2023)

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Element 4 – Video of Resource in Action

In this video you will see the Dienes Base-Ten Blocks in action. They are used to teach a year 6, autistic child how to exchange when subtracting.

<https://youtu.be/DyJlL76A2UE>

Element 5 - Evaluation

Evaluation of Dienes Base-Ten

Zoltan Paul Dienes (1916-2014) was a Hungarian mathematician who developed the field of Psychomathematics (the psychology of mathematics learning), and whose learning theories have had a significant impact in the mathematical educational field (Anon, n.d.). Dienes became intrigued as to why some children found mathematics such a challenging concept to learn and started research in the field. In 1957, Dienes published his initial findings and started creating resources to support mathematical education (Dienes.hu, 2026). Despite ideas of concrete resources being used to teach mathematics, firstly by Froebel and followed by Montessori, it was in fact Dienes that created the *multibase arithmetic blocks* (MAB) later known as Dienes Blocks (Kim and Albert, 2014).

Dienes Base-Ten blocks were designed to give concrete representation of numbers and help learners to understand mathematical concepts such as place value by having manipulatives to calculate math problems (Kim and Albert, 2014). Studies have shown previously that learners using base-ten blocks were able to demonstrate a significantly better understanding of place value concepts than those given standard oral or written instructions (Fuson, 1990). Just by allowing children to participate in the physicality of exchanging ten ones for one ten or ten hundreds for one thousand allows children to learn conceptually rather than procedurally (Fuson, 1990).

So, what is it about using manipulatives that help learners retain and understand? Looking at Jerome Bruner's modes of representation (1966), it is possible to connect the uses of base-ten blocks with the enactive or concrete manipulation (Bruner, 1966). The enactive stage precedes the iconic (pictorial) and symbolic (abstract) stage and Bruner argued that the understanding of concepts developed through these representational stages (Bruner, 1966). Mathematics is renowned for using manipulatives to help scaffold learning thus increasing independent learning and increasing a positive learning outcome (RS Network, 2025).

Due to the Dienes Base-Ten blocks being proportionally accurate, meaning that ten singular cubes in line are the exact size of a ten rod, the correlation between ten ones being equal to ten is visually accurate (Whiteroseeducation.com, 2024). This gives an accurate representation of the numbers so is easier for a child to make the connection between ten single cubes and a ten rod. Learners are then observing the complexity in numerical relationships such as division, multiplication and place value (Kim and Albert, 2014).

Pupils and learners with additional learning needs greatly benefit from using manipulatives such as Dienes Base-Ten blocks to help scaffold their understanding of numerical concepts. It helps learners to build their confidence and understanding of

abstract concepts that may have otherwise caused anxiety (Anon, 2026). The Welsh Government's Guidance to Inclusion and Pupil Support explicitly states that "barriers to learning should be recognised and steadily overcome" (Welsh Government, 2016), which by providing appropriate manipulatives such as Dienes Base-Ten blocks to scaffold and support learning you are acknowledging and reducing those very barriers.

There are limited critiques of Dienes Base-Ten blocks however they are still worth discussion as with any tool or manipulative, improper use can render the tool useless. If a learner was to misinterpret the blocks themselves such as using a ten rod as one as it looks like a single object then the place value process no longer works (Starr, 2021). Unfortunately, if a learner is to use manipulatives without a sound conceptual knowledge, then they are merely playing with the objects with connecting them to mathematical concepts and ideas.

The chance that a learner could become dependant on physical manipulatives such as Dienes Base-Ten blocks and become over reliant on them without the gradual transition to symbolic or mental representations could slow the development of the learner's abstract reasoning (EducationalWave, 2025). It is the role of the teacher or practitioner to ensure the transition from concrete to pictorial to abstract in a timely manner and ensure the retention of the newly acquired skill (Anon, 2026).

There are always going to be practical challenges with any resources in a learning environment such as the cost of the resource, items being misplaced in a classroom and having storage solutions for any large, cumbersome items however Dienes Base-Ten blocks are readily available in both physical manipulatives that can be both bought and made using paper and online for those preferring the digital version.

Conclusion

Dienes Base-Ten blocks are a fantastic concrete manipulative that are able to facilitate learning in numerical concepts inclusively however the need for the interaction to be teacher led is necessary for exploration to be purposeful. A pedagogical approach is key to facilitating learning and reach educational goals therefore using manipulatives to enhance learning through the CPA approach achieves the desired outcome. Teachers and practitioners need to be mindful that they practice inclusivity in the classroom so the use of manipulatives that can scaffold learning creates accessible learning for all (Tjandra, 2023). Zoltan Paul Dienes vision to make mathematics accessible and understandable to all is still impacting today's classroom and despite the advancements in technology, manipulatives are still the key to effective learning in today's classroom.

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