Research Booklet

THE ADVANTAGES OF MOVEMENT AND STORYTELLING FOR LEARNING MATH

MATH&MOVE

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FERMAT SCIENCE
Une autre idée des maths

LogoPsyCom

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1

Introduction

According to a **2019 European Commission report**,[1] to ensure that tomorrow's adults have the essential knowledge to thrive in their lives and be able to **understand and comprehend life in society the best possible way**, mastery or at least **the development of strong skills in STEM subjects and especially math** is paramount. Moreover, it is equally important for society itself, which will remain at a stand still if it is deprived of professionals in the fields of math, science, technology, health, and many others.

Unfortunately, several studies and research like **PISA or TIMSS results (2019)** draw a rather alarming conclusion, showing that in many European countries, the proficiency level of students, especially girls, in these **STEM subjects needs to be improved**. How can this be explained? Indeed, students lack motivation for these subjects, which often seem too abstract and theoretical, but European educational systems also **lack practical applications to transmit and instil a love of learning** to students from an early age.

To address this issue, the ERASMUS+ project "Math&Move" proposes an innovative approach to learning STEM subjects, in particular mathematics through movement and storytelling.

Indeed, numerous studies and research highlight the benefits of this approach and the significant impact it can have on the acquisition of knowledge and skills of all pupils,including those with special needs (such as those with Specific Learning Disorders), from primary school onwards.

[1] European Commission. Directorate General for Education, Youth, Sport and Culture., *Key Competences for Lifelong Learning*.

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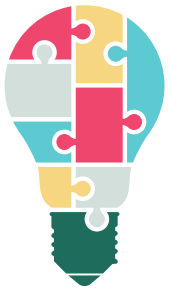
2

The use of innovative approaches for teaching STEM & math



2.1 GENERAL

Innovative approaches exist for improving the learning of STEM and math by using **engaging and collaborative pedagogies** which cater to learners' motivation and interest in these subjects. Therefore, it seems necessary to **guide teachers and families** in this step and inform them about **appropriate and useful tools and methods.**

Before going into more detail on the points put forward in the ERASMUS+ project“Math&Move”, namely movement and narration to improve STEM learning and more specifically mathematics, it is important to know more about these approaches.

Pedagogical innovation is a pedagogical action characterised by the sustained attention paid to students to the **development of their well-being and to the quality of their learning**. In line with the evolution of our world, it is essential to place these methods at the heart of teaching in order to **facilitate learning and give children the desire to learn these subjects**. Here is a selection of existing innovative methods, which aim to create an educational environment adapted to the needs of students.

Cross-learning

This refers to **the link between “formal”** knowledge learned in school **and “informal”**learning acquired during everyday activities such as a visit to a museum. When used as a complement to one another, this method better stimulates the learner.

Learning by augmentation

Argumentation allows for the **development of reasoning skills** and confrontation with other ideas that naturally lead learners to reflection about the content studied.

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Incidental or random learning

This includes unstructured play, varied **communication, listening** to conversations, **stories, and interactions** with family and friends.

Contextualised learning

In a specific context, the learner must consider their acquired **knowledge as a tool to be used in concrete situations related to daily life**. For example, exploring the world withthe help of a guide or measuring instrument.

Conceptual learning

A method such as this is **very useful for example in problem-solving by using "decomposition",** which can look like putting aside details to specify the steps in a recipe you want to share with friends.

The Scientific Method

Based on a real or virtual teaching method, it **allows learners to understand concepts through practice and direct observation**; for example, with remote laboratories or fablabs (which operate as small-scale workshops offering digital fabrication).

Integrated learning

This type of learning refers to **the inclusion of new knowledge to knowledge already acquired**. It is induced by movement and repetition, which call for pupils to carry out actions for a better integration of knowledge.

Intelligent adaptive learning

The goal here is to **adapt learning to each learner's profile** in order to better understand their needs and promote their individual motivation and success

The Flipped Classroom

This references individual learning, generally at home, **allowing pupils** with learning difficulties **to benefit from the support of their peers**, and conversely for students who are more comfortable with the curriculum topic, it reinforces their own understandingand learning by giving explanations.

Productive Failure

It consists of placing students in front of very complex problems to solve before presenting them with the solutions. In this way, **learners perceive error as a positive process, a tool for learning.**

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2.2 INCLUSION OF PUPILS WITH LEARNING DIFFICULTIES

Innovation in the teaching of STEM and math can also positively impact the learning performances of pupils with Specific Learning Disorders (SLD), which studies estimate make up around 15-20% of Europe's population. In particular, **dyscalculia** is an SLD which manifests as difficulty in reading and understanding numbers and arithmetic concepts.

Unlike their peers who can gradually progress from error-prone calculations in math to arithmetic acquisition that is faster and more accurate, primary-aged pupils with dyscalculia and other difficulties influencing math proficiency (such as dyslexia, visual or auditory processing issues, and ADHD) are **substantially less proficient in retrieving theanswers to basic math operations**[2]. Challenges with language processing also come to the fore when completing math problems, such as difficulty detecting relevant versus irrelevant information, misidentifying the proper math operation, and needing help organising the information in the problem[3].

Further, this lack of fluency interferes with more than just a child's ability to perform andunderstand basic math operations. Dyscalculia also affects the development of higher-order mathematical thinking, problem-solving and even working memory[4]– thus, it leads to everyday challenges with remembering tasks, instructions, timetables, etc.

Children with dyscalculia often show slow progress due to a lack of developmental stimuli, low motivation for learning, speech impairments, and slow reactions[5]. Bearing in mind these inhibiting factors, traditional teaching strategies are less equipped to effectively manage and satisfy the diverse learning profiles within a classroom:

- **Traditional math instruction fails to contextualise tasks to real-world situations, making it difficult for pupils to integrate new information into past knowledge[6].**
- **Traditional math resources are limited to pencils, text on paper and whiteboards.**
- **Traditional math testing models forego creativity in problem-solving in favour of academic achievement[7].**
- **Traditional math lectures promote surface-level & impersonalised learning as information is passively consumed and doesn't account for learning differences[8].**

[2] Hasselbring, Lott, and Zydney, "Technology-Supported Math Instruction for Students with Disabilities."

[3] Hasselbring, Lott, and Zydney.

[4] Hasselbring, Lott, and Zydney

[5] Bishara, "Creativity in Unique Problem-Solvingin Mathematics and Its Influence on Motivation for Learning," 5

[6] Hasselbring, Lott, and Zydney, "Technology-Supported Math Instruction for Students with Disabilities.

[7] Bašić et al., "Creativity in Teaching Math to Students with Intellectual Disabilities," 401.

[8] Naz and Murad, "Innovative Teaching Has a Positive Impact on the Performance of Diverse Students," 5–7

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Alternatively, innovative math teaching strategies can lead to greater inclusion of diverse learner profiles in the classroom in a number of ways:

1 Information is presented in a way that is relevant to pupils' everyday lives

Unlike traditional math instruction, math strategies that promote inclusion in education incorporate examples and language that develops pupils' awareness of how math problems can apply to their lived experiences[9]. Therefore, pupils learn to better contextualise the information found in math class with their everyday lives.

In practice, this looks like: Connecting mathematics with real-life situations such as learning addition by ordering from a restaurant menu.

2 Learning is designed to be active and individualised

Inclusion lies in tailoring lectures to the heterogeneous learning needs of a classroom (perceiving each pupil as an individual possessing unique skills)[10] and presenting lectures in such a way for pupils to identify underlying principles and have a deeper understanding of the subject matter[11].

In practice, this looks like: Presenting information with the 'scaffolding' method, so that instruction is first very explicit and gradually becomes more pupil-mediated.

3 Task completion prioritises creativity over standardised tasking criteria

Research posits that math educators should focus on enhancing the creative thinking of pupils with math difficulties and insist on diverse ways of solving mathematical problems,and academic improvement will follow[12].

In practice, this looks like: Encouraging pupils to better visualise math problems by drawing and working in pairs.

4 Pupils are provided digital and visual learning aids to augment text

Innovative math instruction adopts multisensory teaching strategies to engage more than one sense at a time. Educators can easily integrate different forms of multimedia into their assignments to aid in memory retention and class engagement[13].

In practice, this looks like: Using diagrams, graphics and pictures alongside text or combining audio-visual tools in a story format.

[9] Kenyon, "Accommodating Math Students with Learning Disabilities"; Bašić et al., "Creativity in Teaching Math to Students with Intellectual Disabilities."

[10] Bašić et al., "Creativity in Teaching Math to Students with Intellectual Disabilities," 402.

[11] Naz and Murad, "Innovative Teaching Has a Positive Impact on the Performance of Diverse Students," 5

[12] Bašić et al., "Creativity in Teaching Math to Students with Intellectual Disabilities," 402.

[13] Hasselbring, Lott, and Zydney, "Technology-Supported Math Instruction for Students with Disabilities."

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3

The benefits of learning math through movement

By principle, learning is facilitated when it is in association with practice. According to American educational philosopher John Dewey, we learn better when we are totally immersed in the subject.

3.1 WHAT STUDIES SAY

For several decades, **research and studies have been conducted** around learning in general and STEM in particular **in order to evolve educational methods to make them more appropriate and effective**.

By using **alternative ways of transmitting knowledge mixing formal, informal and non-formal education** it is possible to succeed in **instilling a love learning in children** from the earliest age to **enable them to acquire a solid knowledge base in these essential subjectsfor their future growth and learning**.

In general,students see STEM subjects as fields of study that are not very accessible because they are considered too **complex and difficult**. This limiting thought that hinders learners' motivation can be explained by the fact that the **classic model of learning in school** as it has been known since the beginning of the 20th century in Western countries, is most often **the image of a child remaining wisely static on a chair** and facing a board, concentrating on what's being said by the teacher. Unfortunately, this model of learning is too restrictive and can be detrimental to learning because it can be seen as unnatural. Therefore, **one of the key points promoted by this booklet is to get the learner moving in order to promote learning**.

According to Brian Gatens, an American school leader, students should be moving all the time, especially when they are in class. Putting their bodies into action shouldn't be reserved for the playground and physical education and sport. In addition, **a 2013 Institute of Medicine report**[14] **following a study in a school in Sweden found that students who engaged in physical activity more often saw improved academic performance.**

[14] Apsai, "Why Kids Shouldn't Sit Still in Class."

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Hence the **importance for teachers to promote an active pedagogy in STEM learning** in order to optimise the acquisition of knowledge.

Indeed, if we call attention to the basis of the most archaic form of learning, from a very young age we learn in a voluntary and committed way by mimicry and reproduction of an example. Thus, it comes naturally to us to connect knowledge and skills acquisition with action.

The benefits of **movement on learning** are numerous because in addition to **developing motor skills** in a general way, movement also develops **cognitive abilities and brings well-being to the learner**, which contributes to the **improvement of learner motivation and performance**.

Also, as John Ratey, associate professor of psychiatry at Harvard Medical School, says, **movement activates all the brain cells children use to learn**[15].

When it comes to the **biological aspect**, the movement of the body and physical activity in general, brings **more oxygen, water and glucose** to the brain which contributes to increasing the **stimulation of cognitive performance**. This is what has been observed in the Waldorf and Montessori educational models[16]. The rise in good oxygenation levels provided by movement allows for the **relaxation of ocular and muscular tensions, which results in a better focus on specific tasks**.

Integrating movement into a learning method is also beneficial because it places the **learner in the role of an actor**, which is much more rewarding for their performance and motivation. Also, the act of being immersed and carrying out an action **allows for knowledge to be sustained in the long term**.

[15] Apsai, "Why Kids Shouldn't Sit Still in Class."

[16] Grove, "Mouvement et apprentissage."

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Compared to sedentary learning, this kind of active learning is more continuous, more enjoyable and has a notion of sustainability regardless of age, intelligence or type of learner.

Concerning the different types of learners, **it is important to focus on pupils with Specific Learning Difficulties (SLD)**. Whether it is in relation to learning disorders such as DYS-disorders (dyslexia, dyscalculia, etc.) **or even learning disorders induced by an extracurricular context due to socio-economic or other difficulties**.

Several studies and research highlight all the possibilities and benefits of innovative learning approaches that **use movement to make STEM subjects**, and more specifically mathematics, **more accessible to these types of learners with specific needs.**

This **concept of inclusion** has received increased attention in recent years within the European Union and inclusive education has been **part of the European pillar of social rights in a social, educational and cultural dimension since 2017.**

As previously mentioned, the causes of learning disabilities are diverse and what is important to remember is the importance of adapting learning to the specific needs of these learners.

These students are not less intelligent than others, but simply need to grasp knowledge in a different way and in this sense, movement can really be a driving force for them.

Indeed, **movement helps to reduce stress, improve concentration, emotion management and self-confidence**. Unfortunately, it is not uncommon for these students to feel out of step with the rest of the class, especially when it comes to mathematical concepts. It is therefore important to create a climate of mutual trust between the teacher and the student so that the latter feels at ease, takes pleasure in learning and feels valued.

Kinaesthetic learning, which mixes visual and auditory learning elements with movement, **forces the learner to participate fully and allows for gradual knowledge acquisition without mental strain**, which then helps to maintain innovation and attention.

Regardless of pupils'personalities or specifics, movement improves cognitive skills,introduces energy into the learning process and improves performance.

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WHAT WE MUST LEARN TO DO, WE LEARN BY DOING.

- Aristotle

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3.2 EXAMPLES OF GOOD PRACTICES

After having looked at the various innovative approaches to learning, as well as the benefits of movement in STEM learning and more particularly in mathematics, what about existing activities to implement? Here is a presentation of various movement-based learning activities.

The manipulation of elements to learn mathematical concepts such as perimeters and areas

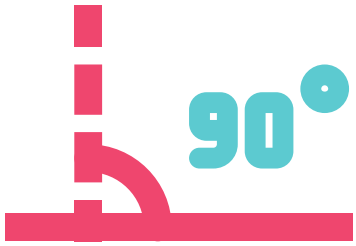
This entails the **construction of**, for example, **geometric figures**, thanks to mobile elements like Kapla or Lego. What follows is then visualising the perimeter, finding relationships between the length of the sides, and reconstituting the area of the figure.

Answer retrieval connected to catching a thrown object

This example is useful for **memorising the possible associations between two lists** in a faster way, because the brain must also concentrate on catching the object.

Learning angles from arm movements

A fun activity to try with pupils is to have them opening their arms (either at a wider or narrower angle), to teach them how to recognise and visually memorise how geometric angles look.



Help with visualisation by walking

Delineate and mark **visual zones on the walking paths** students take around the school to teach for example multiplication tables. Each time they pass by the areas students are obliged to see them.

Physical or virtual escape game

Based on scenarios, this movement-based activity is a **collaborative method** which can be adapted to involve the solving of challenges using mathematical concepts adapted to pupil's proficiency levels.

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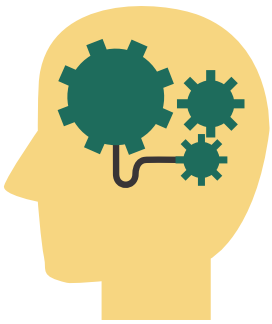
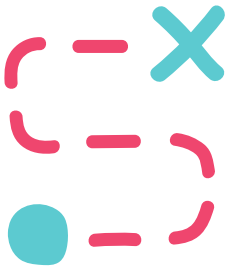


Invent gestural cues to help with memorisation

This practice could be useful to remember the different chapters of a lesson, which helps structure the mind. The pupil could write each chapter on a sheet of paper and then place each sheet in a different part of a room; at each recitation or memorisation, the learner retraces the path in order by mentally reviewing the word associated with each place and says it out loud. At the moment of playback, the child can mentally visualise the room or object and its movements.

Brain Gym

This is a method using movement and artistic activities to improve learning skills. Brain Gym is a set of 26 movements. For example, drawing the letters in the shape of a recumbent figure 8 allows you to photograph them and to absorb the meaning of the letters visually and kinaesthetically in order to respect their writing movements, thus leaving more room for attention, creativity and expression.



Treasure hunt or orienteering race

This might entail learning checkpoints in a schoolyard, but it can also be adaptable to the natural environment or indoors. These activities allow a great diversity of exercises, and for each student to evolve at their own pace.

Dancing

Make mathematics come alive by instructing students to **dance to represent mathematical concepts**. For example, pupils use geometric shapes in a motor way and it is the visual support created (video or photo) that will allow to:

- Institutionalise the mathematical properties of the shapes (vocabulary: sides,vertices....)
- Get the pupils to recognise, name, describe, reproduce, represent and construct some geometric shapes.

There is no limit to the imagination! It is therefore entirely possible to find other activities to promote children's math learning through movement.

"Movement is the doorway to learning."

Paul Dennison, educational kinesiology expert

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4

The benefits of learning math through storytelling

Using storytelling as a tool for learning has stemmed from the need to diversify teaching to adapt to pupils' diverse learning styles. As noted by research from New York University, "the old-school frontal way of teaching serves at most a small fraction of children"[17]. Therefore, applying a story-based learning approach can **answer the need for greater inclusivity in teaching**.

In addition, stories provide learners with context, chronology and linguistic assistance with **their structure, timeline and scaffolding of grammar and vocabulary**[18]. As such,stories enable learners to be better speakers, writers and readers.

But,can such a method be applied to learning more than just literacy concepts? Studies and novel teaching techniques claim just that, advocating for storytelling as a way to **illustrate abstract and complex concepts in STEM subjects**[19]. The logic behind such a technique posits that, since storytelling is an art form that teaches about the human experience, it is also applicable to STEM subjects as they are not outside the world of human experience[20].

[17] NYU, "Storytelling in Teaching and Learning."

[18] Sonnicksen, "What Is Storytelling?"

[19] NYU, "Storytelling in Teaching and Learning."

[20] NYU.

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4.1 WHAT STUDIES SAY

Stories give context to math concepts

Integrating a storytelling approach in math class can provide pupils with the answer tothe question:**"Why are we learning this?"**As younger children struggle with self-motivation, especially for learning STEM subjects, stories are able to bridge the gap from mathematical content to its proper application by **providing pupils with real-world situations** to comprehend and solve math problems[21]. Connecting the elements of a math problem to a familiar context then allows pupils to **arrange and organise the information** more easily into manageable chunks[22].

As discussed in the subchapter "2.2 INCLUSION OF PUPILS WITH LEARNING DIFFICULTIES", pupils that struggle with math-related learning difficulties are particularly responsive to learning strategies which contextualise information as stories are able to do.

Stories activate engagement and emotions during math class

As discussed above, stories make connections to real-life situations to better contextualise problems to learners. Referencing issues relevantto the learner can activate strong emotional responses as they are meant toidentify with the elements woven into the story[23]. Simply put, **stories make us feel** – and beyond that, experts even claim that integrating storytelling into STEM may also boost children social-emotional learning capabilities[24]. Stories integrated into math problems might feature a problem or a crisis in the lives of characters that only mathematical skills can solve.

As pupils become invested in the narrative of the story, which links their imaginations to their emotions, **their engagement with the curriculum increases as well**[25]. This engagement is even more pronounced when pupils have the opportunity to co-create stories in math class, allowing them to impact the process and results of the assignment. The engagement with the learning material, which comes about through identifying and actively being involved in math problem stories, leads to **increased learner motivation to explore the content further** on their own time[26].

[21] Junkin, "Story as a Mathematics Instructional Strategy," 3

[22] Junkin, 3.

[23] Junkin, "Story as a Mathematics Instructional Strategy," 3.

[24] Barack, "Integrating Storytelling into Math Classes Builds Critical, Creative Thought."

[25] Yeo, "Using Maths Storybooks to Engage Children."

[26] Junkin, "Story as a Mathematics Instructional Strategy," 4.

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Stories make math concepts more memorable

Studies claim that people have always used stories as helpful aids to preserve the relationships between events by using stories to trigger memories and index labels[27] – therefore, storytelling is used to better recollect content. Another powerful aspect of storytelling that could enable information to better imprint on the mind is that stories spur the creation of vivid images in the reader's/listener's minds through visualisation. Visualisation of concepts can be achieved either through text or through illustrations aspart of the story, providing learners with helpful representations of abstract conceptssuch as mathematical fractions[28].

In essence, this feature of storytelling helps pupils not only remember the outcomes of a problem but also the entire process which led to its execution, deepening their understanding of the math lesson in question.

Storytelling develops key skills needed for lifelong math learning

True mathematical proficiency requires grasping several skills, sometimes simultaneously, to comprehend the logic and reasoning needed to solve math problems. The way in which stories are structured and relayed to learners can helpin the development of key skills, such as **problem-solving, logic application, analogies, conjectures and communication**[29].

Communication is oft less prioritised when discussing math proficiency, under the beliefthat it is a more pertinent skill for language-learning classes. However, being able to communicate what is being relayed in a math word problem allows pupils to better understand the nature of the math operations needed from them to solve the problem.

Furthermore, mathematical proficiency is not only tied to literacy attainment but also to **improved critical thinking skills, metacognitive skills, self-regulated learning and positivity in lieu of self-critique in the face of mistakes**, as noted by a team of STEAM-education researchers[30]. The scope and importance of the skills attained by injecting stories into math lessons bode well for equipping a generation of pupils with much-needed transversal skills in their adult lives.

[27] Junkin, 2.

[28] Yeo, "Using Maths Storybooks to Engage Children."

[29] Arneja and Tyagi, "The Importance of Using Stories for Teaching-Learning of Mathematical Concepts," 502.

[30] Benjamin, "Storytelling as a Teaching Tool."

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4.2 EXAMPLES OF GOOD PRACTICES

Integrating stories into math lessons needn't be considered abstract and demanding. Word problems to illustrate math concepts are a long-standing staple in the math classroom–your task as a math educator is simply to **transform the dry, uninspired wording in these problems into a text with story elements**, including characters, setting, problem/crisis, and need for resolution.

Here are some examples to follow of how this activity could take place:

Use auditory and visual elements in your stories

Relying solely on text to relay the math problem to your learners is not sufficient! Not only do multimedia elements allow pupils to better visualise the task required of them, but they also ensure that pupils with math-related learning disorders can better comprehend the material.

There are a number of math concepts which can be relayed through visual elements (illustrations, pictures, etc.) in stories. As suggested by a researcher at edutopia, adding pictures to stories about math problems can help children better understand the **conservation of numbers**, ie.to understand that, by looking at a picture, objects don't disappear if they change positions but can instead be tracked and counted. In the same vein, for children that already understand the concept of number conservation without visual cues, you can use images to **help them grasp fractions** by visually dividing and relocating groups of objects, such as apples throughout a house[31].

[31] Barkat, "Using Stories to Teach Math."

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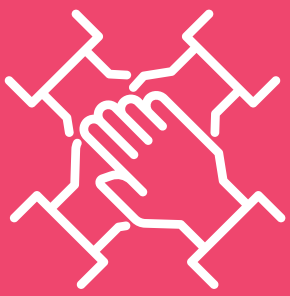
Write problems with which pupils can identify

When traditional math word problems contain dilemmas such as buying carpeting for a new home or needing to calculate how much money is required to buy a house, primary-aged pupils, understandably, fail to relate and engage with the problem.[32] Therefore, it is better to write about content which **coincides with pupils' interests and real-life experiences**. This leads us to our next good-practice example.

Embrace story co-creation

Your stories will be relevant if you ask your pupils to contribute with the topics that matter to them, whether that be playing football with their friends or escaping an alien invasion. Give pupils the autonomy to be involved with **enriching a story outline** (for example, by specifying how certain items can be classified or how much an item costs) or by **writing the math stories anew**, and you will be rewarded with engaged pupils.



Relieve math-related performance anxiety

Learning results need not suffer if there is less focus on traditional performance-relatedcriteria in your stories. Two good practices are having pupils **read the story collaboratively in small groups and being flexible with time barriers**. Pupils that work collaboratively (either by being allocated a particular aspect of the story or tackling it together as a whole) will enrich the groups they are in with their individual skills/strengths, leading to greater efficiency and less pressure. In addition, combating time-related stress can also be achieved by allowing pupils to read the story purely for pleasure the first time, and then going over it the second time with a mathematical lens.[33]

[32] Schwartzbach-Kang, "Learning Math by Seeing It as a Story."

[33] Trakulphadetkrai, "Use Storytelling to Enhance Maths Learning of Your Child, Regardless of Their Age, atHome."

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Ask the right questions with your stories

A math-related story has more than just a beginning, middle and end. It needs to prompt self-reflection in pupils and facilitate information-retrieval, meaning it needs to be **complemented with the right questions**, either given to pupils orally or included in the text of the story. One way you can do this to strengthen the understanding of a key math concept such as, **sequencing**, for example, can be to ask pupils to list the chronology of important events in the story (what happened first, next and last). Another possibility would be to use questions as a way for pupils to **make personal connections to the story**. For instance, one pair of education experts encourage teachers to ask pupils to share experiences in their lives which might mimic a character's predicament in the story to help them better reflect on what task might be needed of them[34].

[34] Goral and Gnadinger, "Using Storytelling to Teach Mathematics Concepts," 6.

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Conclusion

This booklet has strived to provide primary-school educators and their pupils' parents with the needed theoretical background to better understand the **benefits of integrating innovative methods in STEM** and, more distinctly, in mathematics acquisition.

The research-backed information contained in this booklet has showcased the need to diversify and innovate traditional math instruction to ensure **no pupil is left behind**. The gap in mathematical proficiency among primary-school-aged children compared to the EU standard is even more pronounced for pupils with math-related learning difficulties. For these children and others who either face math-related performance anxiety ("mathphobia") or simply struggle to find enjoyment in the abstract nature of the subject, intervention in the form of new teaching tools and methods can make a big difference in **overall satisfaction and learning performance.**

With our project **"Math&Move"**, we've set out to collaborate on creating a teaching & learning method that can be **inclusive of all learners**. The techniques and tools we've promoted in this booklet are **integrating movement in math lessons and framing math problems with the use of stories and storytelling.**

The findings and conclusions we've laid out have been in the form of studies that have been successfully carried out using these methods or the teaching experience of education experts who promote the efficacy of the methods themselves. Of course, as with the application of any novel method, aggravating factors that may come into play might be a lack of equipment, unsuitable class composition or a lack of teacher training. However, this booklet has attempted to include **adaptations that are easily replicable in diverse classrooms** (due to their simplicity, affordability and flexibility in application).

By featuring expert findings and opinions, what we hope all readers take away after having read the booklet is that addressing poor mathematical learning performance and math-related anxiety starts with speaking plainly about traditional math pedagogies: they have become **insufficient in meeting the diverse learning needs of the 21st-century classroom.**

What is now required of educators and parents alike is to embrace 'out-of-the-box' teaching solutions and join the numerous testimonies about their success.

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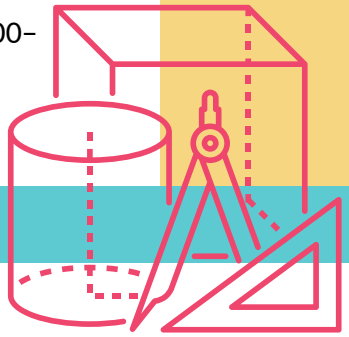

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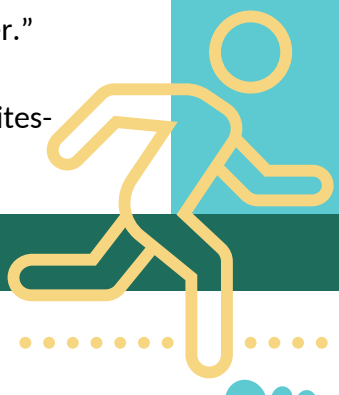

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