Integrated STEM supports a practical learning strategy

Gosport and Fareham Multi-Academy Trust, Gosport

https://gfmat.org/about

Compiled with the help of:

Georgina Mulhall, GFM Executive Head Teacher

Karen Digby, Associate Head Teacher and SEND Leader, Gomer Junior School

Candice Buxey, STEAM KS3 Subject Lead, Bay House and Brune Park Schools (who has since taken up another post)

Pupils from Bay House and Brune Park Schools in Years 8 and 10

Headlines

- Integrated STEM
- Engineering Habits of Mind
- Employer engagement

About the Multi-Academy Trust

Gosport and Fareham Multi-Academy Trust (GFM), located in Gosport, a coastal town in Hampshire, is a partnership between two junior schools, two secondary schools, and one specialist SEN secondary school. A practical STEM curriculum initiative[1] that began in Gomer Junior School is being cascaded across GFM to raise pupils' progress, attainment, and interest in STEM. This case explains how the curriculum is being implemented in two of GFM's secondary schools, Bay House School and Brune Park School.

Making learning whole

Many Gosport STEM employers report that young people lack relevant workplace skills, while many GFM students and their parents are unaware of local employment opportunities in this field. So, with the aim of changing this, GFM Executive Head Teacher, Georgina Mulhall, ensured that Gomer Junior became an early adopter of the Engineering Habits of Mind (EHoM)[2] framework. Teachers at Gomer demonstrated that EHoM could be applied to good effect across all areas of the curriculum to enhance pupils' learning of STEM subjects and develop the transferable skills sought by Gosport's employers.

Reflecting GFM's values by emphasising pupils' futures, the skill set associated with practical learning is as important to pupils' futures as their knowledgebase.

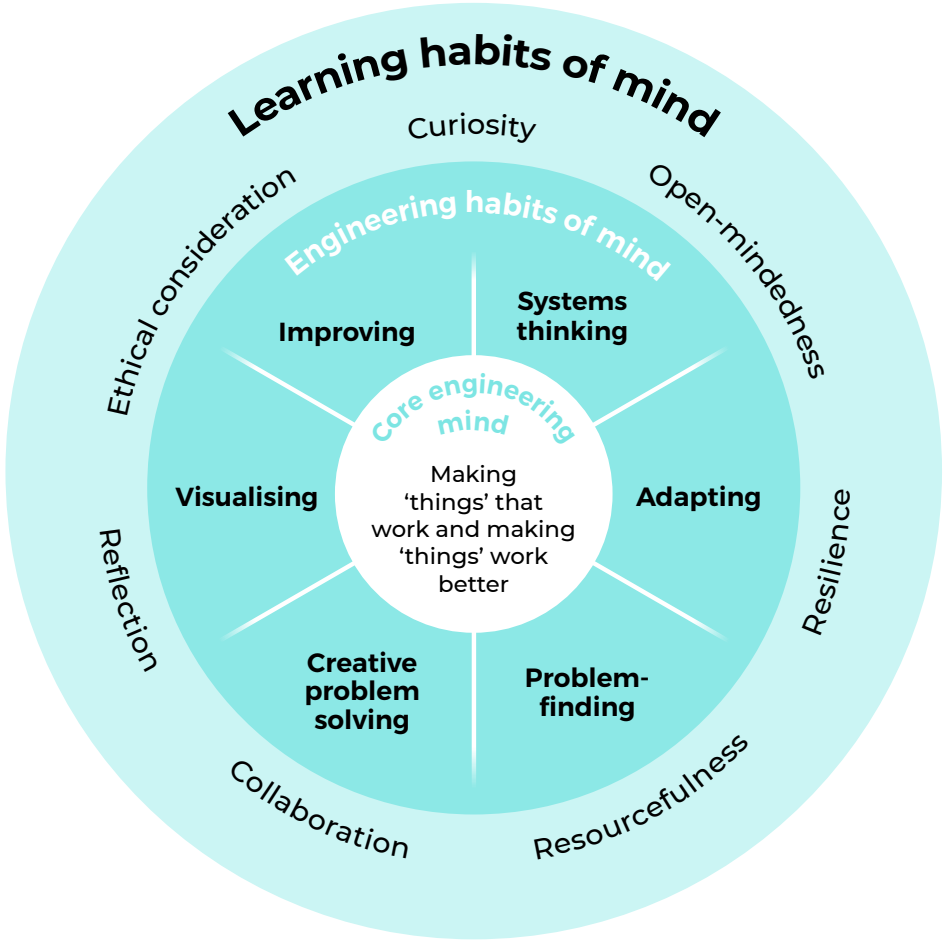
> **'It's important our learners access a curriculum of practical learning to enhance dispositions and skills; something a knowledge only driven curriculum does not provide. Practical learning builds upon academic learning and develops learners as rounded individuals who are better prepared for the workforce'**
>
> Georgina Mulhall

Practical learning in the curriculum for all pupils, regardless of their educational need, is an inclusive strategy that narrows the gap for disadvantaged pupils.

> **'All children are included. They can learn the same as everybody else, in their way, in a way that suits them, and that might be through a practical strategy.'**
> Karen Digby

Embedding practical learning in the curriculum

When Gomer's teachers were introduced to EHoM and the engineering design process, known by the school as the gSTEM Wheel[3], they embraced the integrated project-based approach of the STEM programme and were impressed by the increase in pupils' problem solving and creativity as well as their subject understanding.



After a review of GFM's KS2 and KS3 science curriculum, Georgina Mulhall began an initiative to extend integrated STEM learning underpinned by EHoM across the Trust.

> **'This was not to be isolated to enrichment, but a time-tabled part of the KS3 curriculum.'**
> Georgina Mulhall

By enabling pupils 'to think like engineers' and persuading teachers to build on early successes with EHoM, the aim is to improve learners' progress and raise attainment in science initially and eventually through all subjects. Despite the interruptions of the COVID-19 pandemic, implementation is now well underway in Bay House and Brune Park Schools.

An important instrument for embedding STEM learning within GFM has been the opening of the Gosport STEM Centre[4]. The centre is a purpose-built space for STEM learning that is shared by GFM schools and the local community.

Learning for the real world

At Bay House and Brune Park Schools, the project-based STEM curriculum has been extended by integrating arts to produce a STEAM curriculum.

> **'We decided to add the A to represent Art to make it STEAM, due to the creative industries and the creativity side of problem solving in engineering.'**
> Candice Buxey

An authentic and contextualised learning environment for pupils is fostered through learning strategies that include engineering thinking and the design cycle, and through lessons taking place in the Gosport STEM Centre.

The STEAM curriculum is timetabled to take place in a double period once a week in Years 7 and 8. The project themes and initial 'driving questions' are designed by GFM's team of STEAM teachers. For example, Year 7s have a welcome to STEAM and are presented with a problem where they have to escape from a desert island and Year 8s might have a project for building a moon-base. They will be asked 'We need to get to the moon, and you are going come up with how we're going to do it', 'What do you need to think about?' Pupils produce ideas, create designs, make models and prototypes, and find the STEM Centre environment helps their learning.

> **'When you're in a space and what you're learning is engaged in that space, then that means you get more of what they're talking about to you.'**
> Year 8 pupil

The end product, whether that is a design for a raft or a rocket or related to aspects of daily living on the moon, is not pre-determined. The pupils can follow their own interests, whether that be in biology for food production or textiles for protective clothing. However, teachers do provide some parameters to channel pupils' proposals to ensure that appropriate resources are available. Pupils are expected to do their own research, including seeking advice from others such as food technology or textiles teachers. Pupils work in teams of four or five and teachers manage the group membership to adjust the skill set mix of each group.

Pupils use the gSTEM wheel, renamed STEM Learning Wheel[5], to guide their progress through the project. They must use all the stages of the wheel to demonstrate the rigour of their designs, but they can choose which skills to develop, such as hand-skills in technical

design or using a CAD programme. Pupils find this this combination of structure and choice helpful for learning.

> **'It's good to have a structure, but sometimes I think it's better if you just think. Even if you're thinking the complete opposite of what you're supposed to do, and then you realise that you're thinking the complete opposite, you learn more.'** Year 8 pupil

Companies, including Airbus and BAE Systems, contribute to lessons and pupils visit local employers. The combined impact of this approach raises children's aspirations and shows them that certain careers are not out of their reach.

> **'Children don't often see real-life engineers, so it's nice to put a person in front of them and say that they are an engineer, they build these things, and they actually go into space.'**
> Candice Buxey

GFM's links to Solent Local Enterprise Partnership (LEP)[6] is extremely valuable for initiating and sustaining industry partnerships for GFM and in understanding the skills that employers need for their future workforce.

> **'We're known by the Solent LEP, so they've supported us and showcased us, and I've committed to political engagement.'**
> Georgina Mulhall

Using a full range of teaching methods

Teachers have an important and challenging role in this STEM project-based approach. They have to select appropriate themes, know when to balance instruction with inquiry, structure the tasks, scaffold learning and relate new knowledge to pupils' existing knowledge.

> **'We encourage the teachers to use those 'Engineering habits of mind' to teach our learners ... to think like engineers themselves. The CPD that we have works to develop teachers in how to engage in practical lessons.'**
> Candice Buxey

A lively series of GFM Talks[7] on topics such as embedding EHoM and its pedagogy or using Lego Learning Through Play can be found on YouTube.

Cultivating learner agency

GFM's STEM practical learning curriculum supports the 'whole learner'. Pupils are more engaged with their learning.

> **'If you just sit down and do paperwork lessons, they get pretty repetitive after a while, but if you're doing practicals and other stuff then you'll be more interested in that.'**
> Year 10 pupil

Practical learning enhances pupils' understanding of core concepts:

> **'We were learning about metals in science, and I found it really boring because I didn't get it. I was too nervous to tell the teacher that I didn't get it, but then when we did the practical and I saw how it worked, that made me feel, like, oh, I know how to do this now, so I can do it.'**
> Year 10 pupil

Practical learning enhances pupils' growth mindset so that they are less worried about making mistakes. They see learning as a process of developing and refining their work.

> **'If you go "oh yeah, I think I did that wrong, now I need to do it again", that'll make you feel like you have learned more, rather than just doing it completely right in the first go. You learn more in every go.'**
> Year 8 pupil

Seeing the results of practical learning can make pupils feel proud of their achievements, because:

> **'You feel proud that you've done it, you haven't just been given the answers, you've had to go and find them out yourself.'**
> Year 10 pupil

Teachers confirm the value of practical learning in enhancing pupils' problem-solving skills.

> **'I can see the change in learning behaviour throughout school and the way they work within the other practical subjects. They also embrace the non-practical subjects with their problems solving skills learnt from STEAM'**
> Candice Buxey

Pupils appreciate how practical lessons are important for their future prospects.

> **'It is actually lessons like that, that would set you up for your future in jobs.'**
> Year 8 pupil

Pupil's enthusiasm for learning and engagement with their futures increases.

> **'It teaches you stuff that you wouldn't normally learn in school, because if you wanted to go into an engineering job or whatever, you wouldn't normally get taught that in maths and English.'**
> Year 8 pupil

External visits, like a trip to the London International Shipping Week in September 2021 for Gomer Junior and Bay House pupils, organised by Solent LEP, give pupils insight into marine engineering careers. They are also an opportunity to showcase their own practical skills and knowledge. In this case to

politicians including former Prime Minister, Boris Johnson[8].

Tracking learner progression

GFM's analysis of pupil attainment data in Years 7 and 8 points to improvement in pupil performance and achievement in science but GFM teachers are also establishing methods of measuring pupil progression through the STEM learning journey to demonstrate the value that GFM places on practical learning and skills. They are working with researchers from the University of Manchester to build level descriptors for EHoM use in KS3.

> **'It will support teachers with their subject knowledge and enable them to see how children are progressing'. Also, in the longer term, 'any external validator can see that we'll be able to make judgments on pupils' progress within STEM'.**
> Georgina Mulhall

GFM's STEM achievements for their pupils are widely recognised. Teachers gain national recognition for their inspirational teaching and outreach. GFM and its individual schools have been shortlisted numerous times for the annual Tes Schools Awards[9].

GFM has gained a national reputation for STEM learning.

> **'We're known by the Royal Academy of Engineering; they signpost people to us. We're known by STEM Learning; they trust us with the ENTHUSE projects[10].'**
> Georgina Mulhall

Ofsted[11] also recognises the value of STEM learning taking place in the GFM.

> **'Leaders make sure that pupils learn about the world they live in, as well as the world of the future, through the lens of science, technology, engineering and mathematics (STEM).'**

Finally...

Curriculum change takes time and is a continuous process.

> **'It's never the complete article, and we're still learning and refining – we're comfortable with that. Some colleagues might think that's a bit overwhelming, but I think it's exciting because it demonstrates that we're responding to the educational landscape and to the needs of industry – enabling our learners to leave us equipped to meet the challenges and needs of the 21st century workforce – and that's really important.'**
> Georgina Mulhall

Endnotes

1. https://gomer.gfmat.org/curriculum/gstem-istem
2. https://gomer.gfmat.org/curriculum/gstem-istem/gstem-raeing
3. https://gomer.gfmat.org/curriculum/gstem-istem/gstem-learning
4. https://gosportstem.gfmat.org/home
5. https://gosportstem.gfmat.org/about/pedagogy
6. https://solentlep.org.uk
7. www.youtube.com/watch?v=t2CWTepcCnE
8. https://gfmat.org/boats-bridges-for-gosport-gfm-future-engineers-excite-the-pm
9. https://gfmat.org/finalist-tes-awards
10. https://gomer.gfmat.org/curriculum/gstem-istem/enthuse-partnership
11. https://reports.ofsted.gov.uk/provider/21/144093