THE UNIVERSITY of EDINBURGH
Moray House School of Education and Sport

Shared Learning Spaces

Woodmill High School

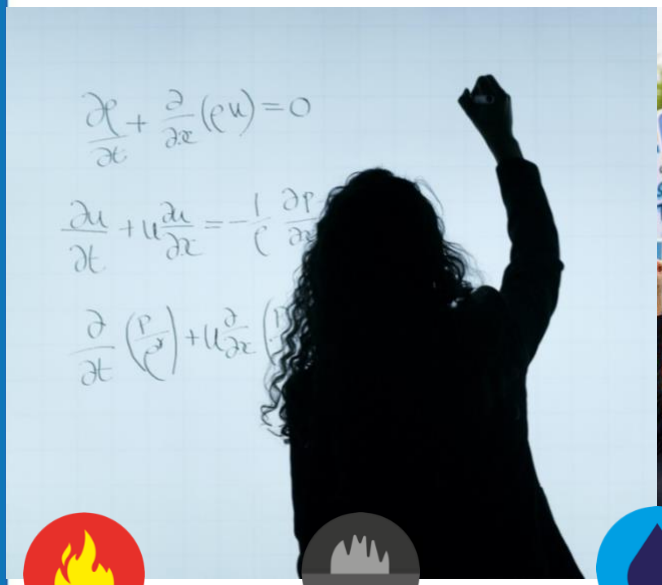
ST COLUMBA'S RCHS

Fife College

STEM Visionaries: Inspiring Spaces, Inspiring Learning

Activists for Inspiring STEM Learning

Project Report



Celebrating the potential of a Fife College, St Columba's RC High School, Woodmill High School, and University of Edinburgh collective

May 2022

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Summary

The Aims:

- We wanted to create opportunities for young people at different stages of their educational journey to share experiences and take ownership of their learning. To ensure that STEM (Science, Technology, Engineering, and Maths) learning is understood and developed in ways which are inspiring and which will influence their future lives, it is crucial to foreground the voice of learners, teachers, and lecturers.

- The catalyst for the project was the development of the new Dunfermline Learning Campus, that will bring together Fife College and two schools, Woodmill High School and St Columba's RC High School, on one site. With a projected completion date for the 2024-25 academic year, our project offered an important opportunity for the learners themselves to influence the design of the new campus.

- Pupils took on the role of '**STEM Visionaries**', while students from Fife College acted as '**STEM Advisors**', and they were set the task of creating a participant-led blueprint for the STEM spaces. The brief of the blueprint was to demonstrate how working with young people to design their learning will empower and inspire them not only to enhance their achievements but also deepen their understanding of STEM now and in the future. They used a Shared Learning Space Design Toolkit, with symbols representing the conceptual, physical and agile elements of learning space design, as a guide and reference.

- By drawing together the perceptions of different learners and their teachers, we hoped to raise awareness across the Dunfermline Campus communities and promote STEM innovation and learning. Our aim was to build a shared understanding of the ambitions for the Dunfermline Learning campus, and investigate how designed, agile spaces can support inspirational STEM experiences.

- A series of workshops actively encouraged learners to explore different ways of experimenting with STEM spaces including using internet resources such as NUSTEM to garner interest. The use of 3-D modelling through digital gaming such as Minecraft was employed to find alternative ways of ensuring more learners felt included and sought advice and support from local enterprise and professionals.

- We also looked to encourage greater understanding of career pathways from inspirational **STEM Experts** and to capitalise on the expertise and advice of teachers and lecturers as **STEM Mentors** to deepen participant awareness and help raise the aspirations of others. Through this, we hoped to raise awareness of STEM related opportunities for employability and lifelong learning.

- The pupils and students also explored ways in which they could communicate their ideas to a much wider audience in a clear and convincing way, proposing different ways of problem solving through active campaigning.

The Outcomes:

- Responses to 93 participant surveys across the schools and college showed that stereotypes about STEM careers being predominantly for white men remain firmly in place. Female participants from a range of different ages and backgrounds spoke about experiencing discrimination in relation to participating in STEM.

- Both the Visionaries and Advisors expressed that they did not feel there was clear, accessible information or guidance about STEM career paths. However, discussing the different challenges and barriers associated with STEM provided a catalyst for the participants to explore ways to tackle inequalities and influence change.

- Although each of the participants had their own ideas about inspirational learning spaces, common themes emerged from the data: they wanted agile spaces that could change and develop in line with different types of learning. The toolkit helped to develop a shared understanding and 'common language' about learning and learning spaces.

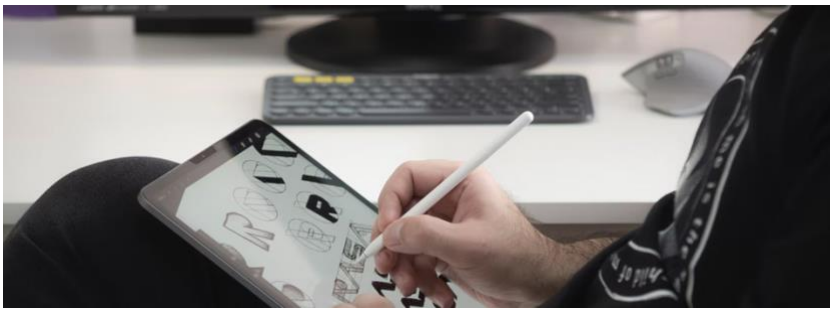
- Many participants talked about how important it was to have spaces for 'teamwork', where they could collaborate and discuss different ideas, but they also called for the introduction of quiet, safe spaces for reflection where they could work independently. Access to the outdoors was also seen as important, and some of the Visionaries spoke about increasingly integrating nature into their learning spaces; they wanted to explore ways to bring the outside in and the inside out.

- The Visionaries highlighted the importance of having 'comfortable spaces' and were aware of how different elements of the design could impact on safety and health and wellbeing. There was a focus on acoustics and noise levels which they felt could impact on concentration and engagement, and a consideration of the need for learning spaces to be inclusive and accessible to all kinds of learners.

- The Advisors discussed not only the visual and physical elements of any potential design, but also explored the reasons and values that underpinned the designs. For them, it was important to communicate clearly why certain decisions had been arrived at and what further improvements and developments could be made: creating and facilitating inspiring learning spaces was therefore viewed as a continuous process and not a one-off activity.

- The Visionaries wanted to communicate their ideas about STEM and inspiring learning through social media, with a plan to reach other young people across the country and further afield. Instagram was described as the most influential and accessible social media platform for promoting STEM to secondary school pupils. Furthermore, as Instagram 'influencers' were seen to be more commonly female, it was seen as potentially a vital tool for helping to increase the female uptake of STEM subjects and careers.

- The Experts and Mentors spoke about developing environments for STEM learning where experimentation was encouraged (by teachers as well as learners), so that learners could take the lead. They talked about fostering a sense of 'continuous curiosity' and creativity in combination with the structured thinking associated with STEM, which they felt would keep subjects 'endlessly fascinating.'



The Impact:

- **Challenges and Stereotypes**: There is still a lack of access to careers in STEM in terms of gender balance, and a lack of transparency about career pathways open to all learners, with evidence suggesting that views like "STEM is for geeks" and that "physics, engineering, and computer science are male-dominated" continue to be common. Visionaries accepted that perceptions need to be changed, through teaching and learning, with more positive messages that *STEM is for everyone*.

- **Skills and Employment:** Learners must have opportunities to experience a greater depth of a particular subject or cross-disciplinary project-based learning before they choose to take it up in S3. Learners need ongoing opportunities in STEM, not just one-off events. The new learning campus itself could be a 'go to' Scottish hub for careers and employment advice and opportunities.

- **Inspirational Learning Spaces:** Having a combination of open-plan spaces, classrooms, and places where learners can huddle or learn independently can support different types of learning. More consideration could be given over to designing a STEM learning Lab which, given the strong messages articulated by participants, should not be a replica of a traditional science lab in a classroom. Providing comfortable and agile furniture that can be easily moved to meet the needs of different types of learning activities was communicated, particularly by the Visionaries, as essential. Having more flexibility in the classroom would enable young people to have agency over their learning and in rethinking the environment to support rethinking STEM.

- **Influencing Change:** The participants felt strongly that what makes STEM inspirational is providing equitable experiences, and creating innovative and exciting futures thinking spaces where everyone has a role and is valued. There needs to be consistency and momentum in promoting STEM to all learners.

- **Learner Voice**: There is a need for further consultation with learners, with many ideas, worries and concerns about the new campus shared during the project. The schools are planning and organising for the architects to come in and gather perspectives from pupils, and this approach should be encouraged at all stages of development.

- **Connections:** Evidence suggests that there needs to be a neutral space within the new campus, away from the classroom, that is designed to encourage conversations and connections between teachers and pupils. Holding a workshop with teachers about designing a space that encourages collaboration would aid with this. The campus will naturally bring together many learners (and teachers) of different ages and stages, and it is important that the potential for connections is realised through the design of the space.

- **Integrating different (learning) cultures:** There are different learning and teaching approaches at school and college, and these differences need to be acknowledged and promoted in the new learning campus. A Learning Lab may offer new opportunities for sharing, learning, and collaborating. Likewise, it is important that different backgrounds, cultures, and experiences are reflected in a holistic way in the new design - learners and teachers should be able to 'see themselves in their environment.'

- **Shared Learning Design:** There is scope for organising more discussion *between* the school pupils and college students, particularly considering the cognitive aspects of design, and exploring the different expectations that learners have about the new campus. Such community-building could involve gathering and working through these different views, to develop the potential to create dynamic and inclusive spaces that inspire all different types of learning, including STEM.

1. Introduction

1.1 Regional Skills

Regional Skills is a programme that the University of Edinburgh has been developing over the past two years in partnership with Fife College, Edinburgh College, and other regional organisations. The aim of the programme is to look at new ways of developing skills and supporting local and regional economic needs. Following on from a pilot project in 2021, the Shared Learning Spaces Team was awarded funding from Regional Skills to explore spaces for STEM (Science, Technology, Engineering, and Maths) learning with partners from the Dunfermline Learning Campus: Fife College, Woodmill High School, and St Columba's RC High School.

1.2 Shared Learning Spaces

The Shared Learning Spaces (SLS) Team at Moray House School of Education and Sport, University of Edinburgh, seeks to connect with schools, colleges, and the university across our partnership for the exploration and development of shared working practices which actively benefit pupils, teachers, student teachers and educators.

Our projects explore the potential of shared learning spaces for deepening learning and how these spaces influence the quality of learning. We also investigate the outcomes of directly involving learners and educators in the design and research of these learning spaces, and how an exploration of SLS can enable a reconceptualization of attainment focussing more on problem-solving and achievement. The SLS team works with partners such as Architecture and Design Scotland, Scottish Futures Trust, and international colleagues to facilitate cross-sector, collaborative, and pioneering work that seeks to place the learner at the heart of learning space design.

2. Project Outline

2.1 Key Drivers

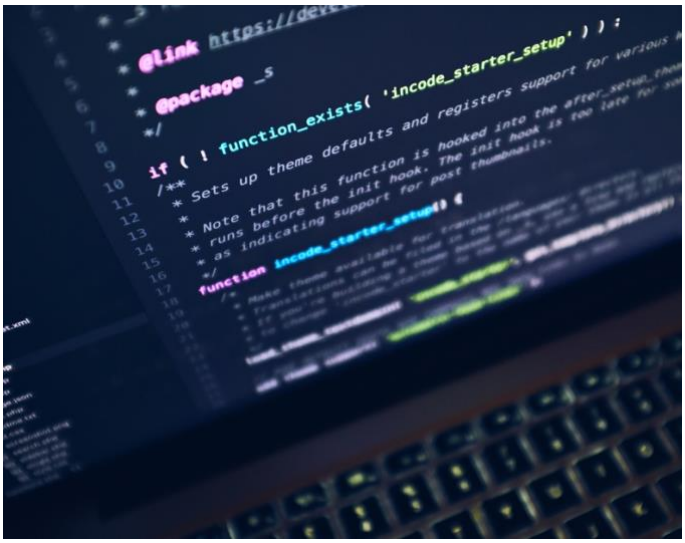
One of the key aims underpinning this initiative was to explore what lies beneath fit-for-purpose, inclusive contemporary and futures learning, and in what ways this might be actioned by young people. We wanted to create opportunities for young people at different stages of their educational journey to share their experiences and take ownership of their learning. To ensure that STEM (Science, Technology, Engineering, and Maths) learning is developed in ways which are inspiring, it is crucial to foreground the voice of learners, teachers, and lecturers.

Our goal was to **invest in young people as STEM Visionaries and STEM Advisors**, to understand how they themselves can develop the skills and thinking which can improve the design of learning and learning environments. At the same time, we wanted to **capitalise on the expertise and advice of teachers and lecturers as STEM Mentors**, as well as **STEM Experts with careers in STEM**, such as Chris Rothwell at Microsoft UK, Claire Jackson from Galliford Try, and Carol Davenport at NuSTEM. In doing so our aim was to contribute to and facilitate learning spaces for collaboration and creativity where everyone feels they have an important role to play.

The catalyst for the project was the development of the new £180 million Dunfermline Learning Campus, that will bring together Fife College and two schools, Woodmill High School, and St Columba's RC High School, on one site. With development now underway and a projected

completion date for the 2024-25 academic year, our project offered an important opportunity for the learners, and teachers and lecturers themselves, to influence the design of the new campus. This project builds on a pilot initiative from 2021 in which learners from Fife College, Woodmill, and St Columba's worked together to design learning spaces for the new campus, using a shared learning space design toolkit. The pilot won the Fife College Student Association's *Campaign of the Year Award* in October 2021, which recognises initiatives that have made a difference to students.

Research has shown that the way in which learning spaces are designed has a direct impact on learning (Bradbeer et al., 2017; Barrett et al., 2015; Ellis & Goodyear, 2018; Jenoveba Calvo, 2019; Mulcahy, Cleveland & Aberton, 2015). Despite this, it has become clear that the potential of learning spaces is yet to be fully harnessed (Coyle et al., 2021). Through this project we wanted to give young people a platform to design their own learning environments that are agile, sustainable, and owned by learners; in other words, **spaces that are integral to their own learning**.



It is widely recognised that realising the potential of STEM learning is crucial for developing innovative, inspiring, and futures-looking societies. The Scottish Government has stressed that STEM skills, knowledge, and capability are vital for adapting and thriving in a fast-paced world and economy; and have never been more relevant "as we face the challenges of a global climate emergency, uncertainty arising from the UK's exit from the European Union, and the need to recover from the COVID-19 pandemic" (Scottish Government, 2021, 2017). While Scotland has a rich history of achievement and innovation in STEM, it also encounters many of the challenges faced by countries across the world in terms of access to and equality in STEM education. Women and ethnic minorities are often underrepresented in STEM fields, which has been linked to a lack of encouragement, opportunities, and pathways in education (Buck, Francis & Wilkins-Yel, 2020).

Therefore, through the design of STEM learning spaces, we were also looking to provide opportunities for young people to **develop a range of skills relevant to the dynamic nature of employment and life skills in the 21st Century**: criticality, resilience, global awareness, curiosity, and dealing with uncertainty, to name a few. In response to concerns about inequalities and barriers in STEM education, the young people in this project were set the task of exploring alternative ways of designing STEM learning and teaching, and **adapting their learning spaces to meet the needs and aspirations of all learners**.

2.2 The Aims

Through this initiative, we wanted to:

- **Engage young people** to improve STEM learning and environments for teaching STEM in our schools and colleges.
- Understand young people's **perceptions of STEM learning**, to raise awareness and promote innovation in the field.
- Encourage learners and teachers to explore **STEM-related futures thinking and 'curriculum'**.
- **Empower young people** to investigate, design, and own learning.
- **Promote shared learning** across both schools, Fife College and beyond via STEM.
- Raise awareness and recognition amongst young people about **opportunities for employment and lifelong learning**.

2.3 Project Design

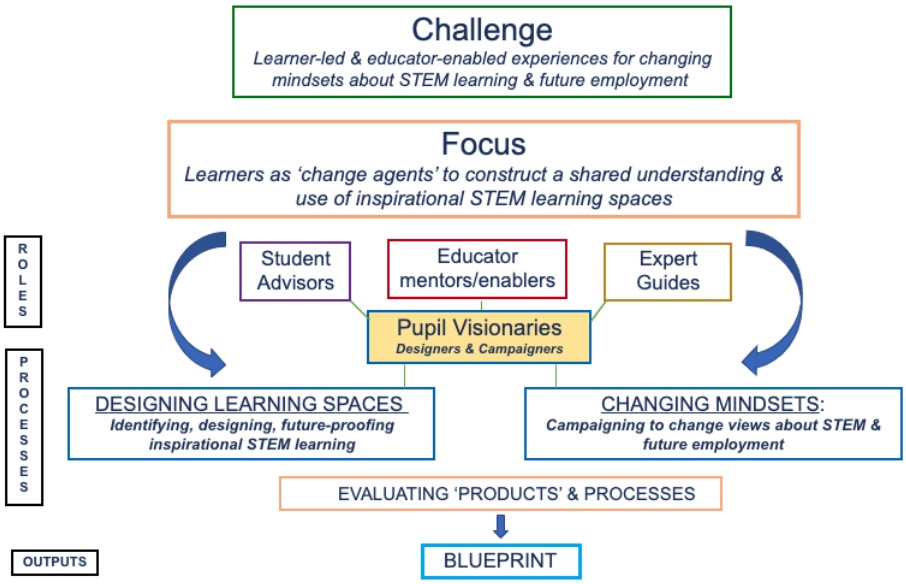
To design inspirational and fit-for-purpose learning spaces that encourage participation in STEM, teams of representatives volunteered at each of the institutions involved in the new Dunfermline Learning Campus: Fife College, Woodmill High School, and St Columba's RC High School.

The pupils at Woodmill and St Columba's took on the role of '**STEM Visionaries**'. Platforms were created for learners to develop agency over their learning spaces, through engaging with digital catalogues, developing a campaign for STEM, and applying the Learning Space Design Toolkit (see below). They were also tasked with considering how best to communicate their ideas and pioneering work to a range of audiences.

At Fife College, a group of students volunteered to act as '**STEM Advisors**' to the STEM Visionaries. This Advisors group comprised both students who were studying a STEM course (e.g. Applied Biological Sciences, Mechanical Engineering) as well as students with no background in STEM (e.g. Counselling, Fashion Design students). The latter group played a pivotal role in this project, as they helped to uncover ways that STEM could be improved, made more accessible, interesting, and engaging for future learners. The Advisors were asked to engage in critical thinking and problem solving, and offer reflections, advice, and suggestions for change.

A group of '**STEM Mentors**,' including teachers and lecturers from the schools and College acted as a support network and fed in their own ideas and expertise on STEM learning. Finally, a small group of '**STEM Experts**' were invited to provide examples from their own experiences and career pathways, serving as inspirational case studies of success in STEM. This group of experts included Chris Rothwell, Director of Education at Microsoft UK, and Claire Jackson, Education Director at Galliford Try.

A key outcome from the initiative was the development of a participant-led *Blueprint for STEM Spaces*, which demonstrates how working with young people to investigate, design and have agency over their own learning will empower and inspire them to learn. Furthermore, these findings will help to inform decision-making and contribute to the design of the campus.



Design of the initiative

2.4 Activities

Participants were asked to complete a survey, with the aim of uncovering attitudes about STEM learning and to capture what they find inspiring in terms of learning activities and space. The surveys asked similar questions but with some tweaks and additional questions tailored to the participant groups: STEM Visionaries and STEM Advisors. There were 93 responses to the surveys.

The STEM Visionaries and STEM Advisors were asked to:

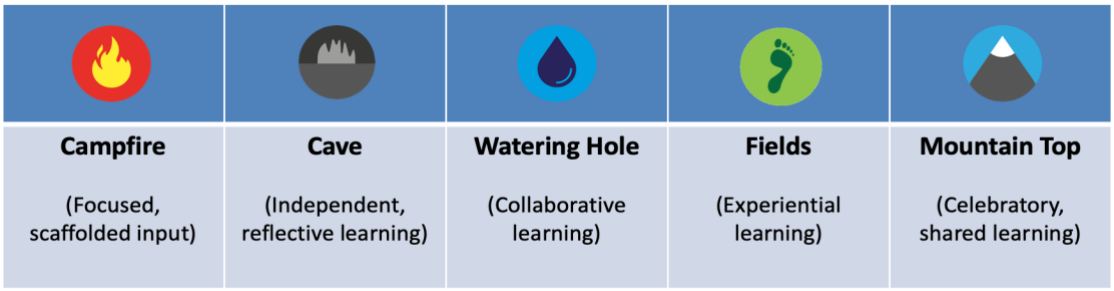
- **Collaborate on the design of agile STEM learning spaces** based on near futures thinking (values and skills) for contemporary learning.
- **Work in groups** to share and sketch out their ideas and aspirations for how STEM spaces might and can be used.
- **Participate in a series of workshops**, refining their ideas and designs with reference to a Learning Space Design toolkit (see below) and explore ways to promote inspiration thinking about STEM to a range of audiences.
- **Develop a participant-led *Blueprint for STEM Spaces*** and present this to key stakeholders including Fife Council, Fife College, and the Dunfermline Learning Campus Board.

In addition, a series of interviews were conducted with teachers and lecturers at Fife College to gather their perspectives on attitudes towards STEM, attracting a broader range of students to study STEM, and the importance of collaborative and inspiring learning spaces to engender greater understanding of the impact of STEM in their future lives. The COVID-19 pandemic had an impact on the project, as it was not possible for researchers to visit the college for some workshops, so certain events had to be held online on Microsoft Teams. The initiative therefore took on a hybrid approach where some activities took place face-to-face and others online. Throughout the project activities, however, there was an emphasis on participatory action research, in which all participants worked collaboratively with the researchers to tackle the key questions and challenges raised by the initiative. The participants were also empowered to work independently at certain stages of the project, before gathering to discuss and reflect on their innovative ideas for change.

2.5 The Shared Learning Space Design Toolkit

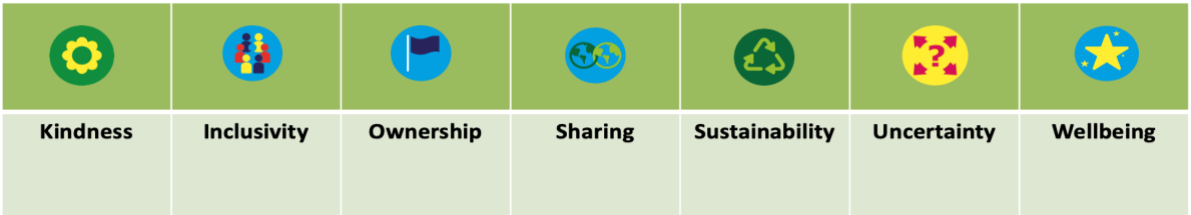
The toolkit is a dynamic resource for learners and educators designed to trigger discussion and collaboration on the co-design of educational spaces, promoting innovative and sustainable learning that is accessible for all. It contains sets of symbols which aim to make the principles of learning space design accessible to a wide range of users, from professionals in the field, such as architects and engineers, to national agencies, educational leaders and learners. The symbols were developed in collaboration with teachers, pupils, and designers to promote exploring and testing learning spaces.

- **Learning Typologies:** The different 'types' of learning that are fundamental to schooling. The symbols signify different spaces: input-driven, scaffolded, independent, reflective, collaborative, experiential, celebratory, and so on. The symbols can be used to map out in meaningful ways how learning spaces promote different kinds of learning.



Learning Space Typologies, adapted from David M. Thornburg's (2007) Campfires in Cyberspace: Primordial Metaphors for Learning in the 21st Century.

- **Learning Design Values:** The values that underpin design for learning in these spaces, including inclusivity, ownership, and uncertainty.



Learning Space Design Values developed by The University of Edinburgh, Architecture and Design Scotland, and City of Edinburgh Council.

The symbols bring together the conceptual, physical, and agile nature of learning space design. They provide a 'common language' between teachers, pupils, and designers for discussing, collaborating, and co-creating spaces and the learning that takes place within them. The Typologies and Values were used by the STEM Visionaries and STEM Advisors to discuss what they viewed to be the most important elements of learning space design, and the learning that takes place within them.

A snapshot of the toolkit with further information is accessible online here.

3. STEM Visionaries

As STEM Visionaries, the school pupils were encouraged to be contributors, explorers, and articulate, creative problem-solvers. As well as developing the learning space designs, they explored ways in which they could communicate their ideas to a range of audiences in a clear and convincing way.

The workshops with the Visionaries took place in person, with nine pupils taking part at Woodmill and 19 pupils taking part from St Columba's across two workshops. They agreed to act as representatives for the wider school population, discussing their ideas and taking on advice and suggestions from other pupils not directly involved in the project.

During the workshops, the STEM Visionaries:

- Discussed the **principles** of the project, their **role** within it, and **what it means** to be a 'STEM Visionary.'
- Reviewed **disruptive questions** and explored and **challenged their current perceptions of STEM** with the aim of uncovering some of the barriers and reconsidering issues of accessibility to STEM.
- Developed ideas related to collaborative work and making their voices heard and proposed **different ways of problem solving through active campaigning**.
- Reflected on **what makes an inspiring learning space**, how space can **impact on learning**, and researched their own examples of learning spaces.
- **Showcased their annotated digital catalogues** and discussed inspiring learning spaces and the **skills needed for STEM and future employment**.
- Explored the **Learning Space Typologies**, what these different 'types' of learning look like in their current spaces, and how they might be integrated in their designs for the Blueprint.
- Developed their **role as researchers** and were tasked with **developing and distributing a survey about STEM** tailored to a high school audience.

4. STEM Advisors

As STEM Advisors, the college students were asked to develop roles in which they could draw on their own experience of learning (both STEM and non-STEM focussed) to offer advice and expertise. As well as thinking about learning space design and its impact on their own learning, they focused on ways to communicate and collaborate with young people. They considered how as adults they prefer to learn and the impact of the environment on their attitudes to different subjects. They discussed the importance of rethinking STEM to change mindsets.

The initial workshops with the STEM Advisors took place online, with later meetings taking place face-to-face. A group of 12 Advisors took part in the first online workshop, which included three breakout discussions. Following on from this first workshop, a final core group of four Advisors were identified. Of these four students, one studied a STEM-related subject, while the others studied Professional Cookery, Art and Design, and Counselling. An additional four workshops took place as the core group of Advisors further developed their ideas and devised a range of strategies for communicating their views on STEM learning spaces.

During the workshops, the STEM Advisors:

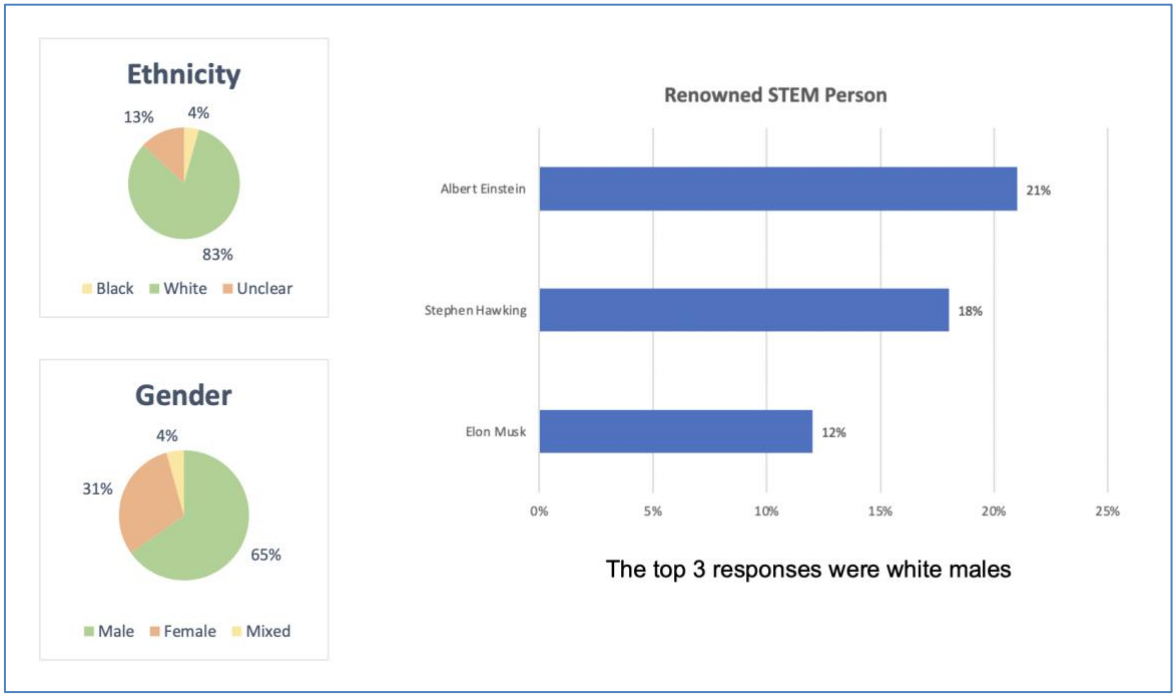
- Discussed their **role** as 'STEM Advisors,' and **what makes learning spaces inspiring**.
- Reviewed **disruptive questions**, and explored and **challenged their current perceptions of STEM**, with the aim of uncovering some of the barriers and reconsidering who STEM is accessible for.
- Explored the **Learning Space Design Toolkit** and how this could be used to **facilitate discussion** about the different elements of STEM learning design.
- Developed their **role as researchers**, discussed the **importance of gathering data** and were tasked with **developing and distributing a survey** about STEM.
- Showcased their **annotated digital catalogues** and discussed inspiring learning spaces and the **skills needed for STEM and future employment**.
- Took the lead in the final workshop and **prepared for recording a discussion** in which they discussed**: inspirational learning spaces**, **STEM attitudes and stereotypes**, and **advice for both young people and teachers** in relation to STEM.

5. Impact

5.1 Attitudes to STEM

In the survey (n = 93 learners), participants were asked "*who springs to mind as a famous, inspirational, or renowned STEM advocate?*". The top three answers were all male and white experts: Albert Einstein, Stephen Hawking, and Elon Musk. A notable number of responses (18%) stated that they were 'not sure' of any STEM experts. This suggests that while there have been

growing calls for greater equality across society and especially amongst young people, stereotypes about STEM remain firmly in place.



In the workshops, some of the female STEM Advisors spoke about feeling discouraged from taking part in STEM learning, despite being interested and passionate about it. They talked about stereotypes being reinforced and being told that STEM subjects were "mainly for men."

> ***"I wanted to be an engineer… but I was told girls don't have the good muscles for it."*** **– [STEM Advisor]**

Female participants also recalled being told that they "weren't smart enough" and were subsequently facing additional barriers and challenges in STEM learning.

> ***"My friend is a woman in STEM and wasn't allowed to re-sit physics… they eventually let her resit and she got an A."*** **– [STEM Advisor]**

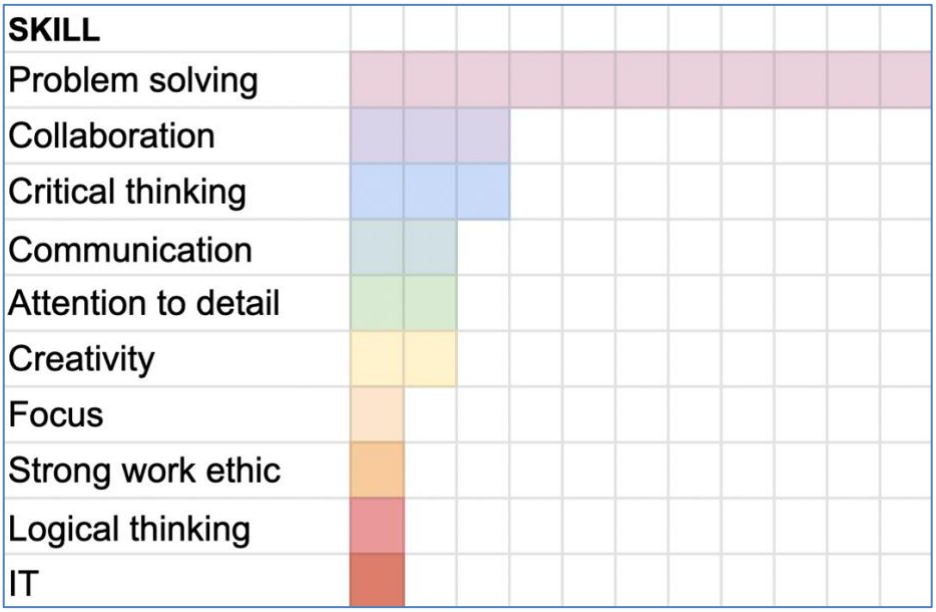
In addition, both STEM Visionaries and Advisors expressed that they did not feel there was clear, accessible information or guidance about contemporary career paths and the steps needed to get there. They felt that introducing these links from "a very young age" could reduce stigma and improve equality.

> ***"I did think of being an engineer. But to further progress that, there was a lack of information being put around, including in high school. Teachers aren't fully trained to talk about STEM, not even Science teachers"*** **– [STEM Advisor]**

Discussing the different challenges and barriers associated with STEM provided a catalyst for the participants to explore ways to tackle inequalities and influence change through their design of campaigns and inspirational learning spaces.

5.2 Skills for STEM Learning and Employment

The STEM Visionaries and STEM Mentors discussed the different skills that were required for STEM jobs in their workshops and recorded them in the surveys. "Problem-solving" was considered by far the most important skill, while "critical thinking" and "collaboration" were also highlighted among the 25 Visionaries taking part in the survey.



Rainbow analysis illustrating how many participants stated each response

In the workshops, the Advisors also discussed different types of skills they felt were important for making STEM learning more inspiring. As well as problem-solving, they also highlighted "*open-minded thinking*" and called for fewer boundaries and more flexible learning.

Notably, two of the four STEM Experts mentioned that they had gained most of the skills relevant to their career *after* leaving school.

> ***"Most skills that I use today I actually learned after school and outside of courses" [STEM Expert]***

> **"*I particularly enjoyed Maths and Chemistry, but back then I was very much steered towards Humanities*." – [STEM Expert]**

This suggests that there are gaps in the curriculum and teaching in terms of developing these skills and making explicit how transdisciplinary skills are fundamental for STEM jobs. As the second above quote is from a female Expert, it also links to some of the stereotypes and challenges presented for women and girls looking to get involved in STEM. Participants called for further opportunities to engage in problem-solving and critical thinking in school and in college, and for greater transparency around pathways to careers in STEM.

The initiative itself was seen to have provided some opportunities of this kind to participants, creating spaces and platforms where they could work together to identify problems and articulate innovative solutions. The fact that the Advisors worked across a variety of different subject areas,

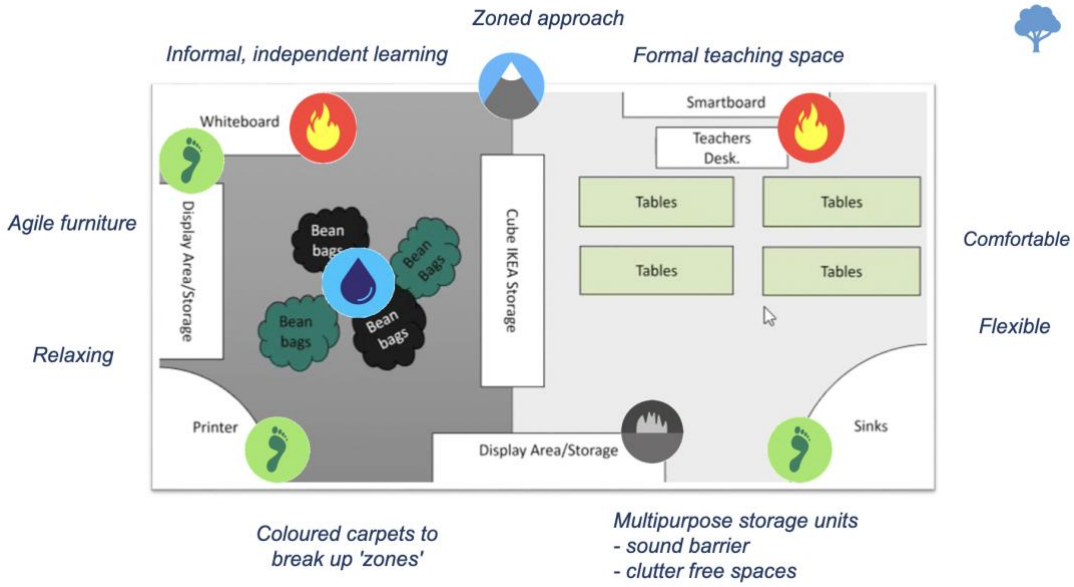
including Science, Professional Cookery, Art and Design, and Counselling, helped to facilitate cross-disciplinary learning; the students expressed that this helped to broaden their skills and helped to identify their own strengths and knowledge.

The Advisors involved in the project felt they had developed different skills through the initiative, including presentation and communication, teamwork and collaboration, and criticality, and believed that the experience had increased their confidence and future job prospects.

5.3 Inspiring Learning Spaces

In the workshops, the Visionaries and Advisors highlighted what was most important to them in their learning spaces. Although each of the participants had unique ideas, there were common themes that emerged. In particular, they wanted agile spaces that could change and develop in line with the different types of learning that might be taking place.

There was discussion around how the STEM learning spaces might impact on the types of learning represented by the Toolkit Typologies, with areas designated for sharing (Campfire), discussion (Watering Hole), practical activities, experimentation and creativity (Fields), celebrating achievements (Mountain Top) and independent study (Cave). The toolkit helped to generate conversations around different types of learning and learning spaces, and developed a shared understanding and 'common language' amongst the participants.



Many participants talked about how important it was to have spaces for 'teamwork', where they could collaborate and discuss different ideas. The Visionaries spoke about the "***different people you spend your day with… and different environments,***" suggesting a need for flexible learning spaces where they could meet and share ideas with different learners; something that the new learning campus – bringing together two schools and a college – has the potential to provide. Some also wanted open-plan spaces where they could be 'visible' to the teacher, so that they could receive support with different learning activities.

In addition to collaborative spaces, the Visionaries and Advisors called for the introduction of quiet safe spaces for reflection; peaceful and closed-off, yet spacious, places where they could move to work independently.

"*Your own bit where you can focus on yourself*" – [STEM Advisor]

"*In my course, you don't really have much personal space… we need a big personal space, but it's hard to get*" – [STEM Advisor]

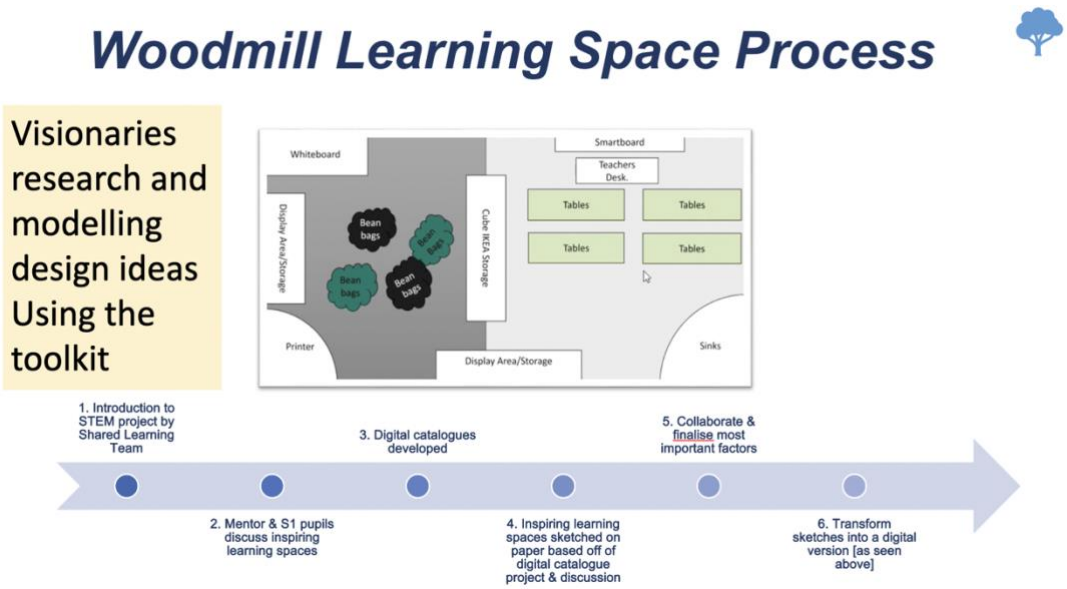
Access to the outdoors was also seen as important, and some of the Visionaries spoke about wanting "***more natural light***" and biophilic design so that nature was an integral part of their learning spaces; they wanted to explore ways to bring the outside in and the inside out. They also prioritised 'comfortable spaces' and talked about moving away from ***"hard materials"*** and ***"hard plastic chairs".*** A solution the Visionaries and Advisors came up with were ***"bean bags"*** and ***"cushions"*** to suit different learning activities, for instance sitting away from rows of desks and instead on bean bags for reading or reflective tasks.

At the same time, they were aware of how different elements of the design could impact on safety and health and wellbeing. There was a focus on acoustics and noise levels which they felt could impact on concentration and engagement. Part of this was a consideration of the need for learning spaces to be inclusive and accessible to all kinds of learners.

***"People with autism don't like bright lights or loud noises"* – [STEM Visionary]**

***"Tables that don't all have high chairs… if you had a wheelchair, you wouldn't be able to get in"* – [STEM Visionary]**

This was a key part of the discussions held by both the Visionaries and the Advisors. They wanted to champion the wider experiences of learners at the schools and at the college, and think about the ways that the learning spaces at the new campus could enable everyone to feel equal and included. It was felt that problem-creating and problem-solving spaces needed to be equipped with appropriate specialised equipment but that it should not dominate the spaces – problem-solving required more than working in the 'field'. The Advisors in particular wanted to discuss not only the visual and physical elements of any potential design, but to also explore the reasons and values that underpinned their choice of designs. For them, it was important to communicate clearly why certain decisions had been arrived at and what further improvements and developments could be made: creating and facilitating inspiring learning spaces was therefore viewed as a continuous process and not a one-off activity.



5.4 Influencing Change

The participants were encouraged to engage in problem solving through the design of campaigns, and think about practical ways of making their voices heard and influencing change. The Visionaries wanted to communicate their ideas about STEM and inspiring learning through social media, with a plan to reach other young people across the country and further afield. Instagram was described as the most influential and accessible social media platform for promoting STEM to secondary school pupils. Furthermore, as Instagram 'influencers' were seen to be more commonly female, it was seen as potentially a vital tool for helping to increase the female uptake of STEM subjects and careers.

The Visionaries discussed organising short promotional videos on Instagram with people from all different kinds of STEM subjects and backgrounds who could talk about their experiences and break down barriers and stereotypes associated with STEM. The videos would filter in STEM information based on a user's interest and give them the option to 'learn more' about career pathways; for example, if the user is interested in cars, a short video would be provided about a mechanic's career pathway with links to videos with further information and connections to STEM learning. The Visionaries also explored different ways of experimenting with STEM spaces including using internet resources such as NUSTEM to garner interest. 3-D modelling through digital gaming such as Minecraft was used to find alternative ways of ensuring more learners felt included and sought advice and support from local enterprise and professionals.

The Advisors and Mentors discussed the ways forward and future planning to ensure that the issues they had engaged with remained on the agenda, in the design of the new campus and also in conversations about STEM learning and learning spaces in general. In their key messages, the Advisors, again, emphasised the importance of agile learning that could include spaces for both collaboration and independent inquiry, tailored to the individual.

> ***"Collaborate with peers to enhance learning"*** **– [STEM Advisor]**

> ***"Learn in a way that suits you"*** **– [STEM Advisor]**

Specifically in relation to STEM, they discussed how links to STEM learning could be made more explicit in a range of different subjects and activities; for example, they spoke about the elements of the Professional Cookery course that included STEM. By engaging with topics and subjects that learners are enthusiastic about, the Advisors believed that STEM learning could become more engaging and inspiring; as one participant put it: "***find the STEM in what you love***."

The Experts spoke about developing environments for STEM learning where experimentation was encouraged, and learners could lead on their own projects and feel like "***it's okay to get things wrong.***" They talked about fostering a sense of 'continuous curiosity' and creativity in combination with the structured thinking associated with STEM, which they felt would keep subjects 'endlessly fascinating.'

> ***"In Art I thought the core structure of the course was really good, as you got to run your own projects. The STEM subjects didn't really let you do that"*** **– [STEM Expert]**

> ***"I definitely enjoyed that combination of both the technical understanding of how things worked, but also the creativity of needing to imagine and build things that are new… it felt really creative and rich and diverse"*** **– [STEM Expert]**

Building on this, Mentors discussed ways in which they aimed to provoke curiosity and keep their students engaged during a lesson through applying real life application and enjoyment, whilst encouraging innovation as part of STEM learning. One Mentor explained that his students would be shown snippets of a movie as part of the theory, perhaps making the experience more memorable than traditional methods of learning, and would then be tasked with completing a practical activity.

> ***"I did DNA extraction from strawberries and kiwi fruits… I used to show [the students] the classic clip from Jurassic Park where Mr. DNA comes out… We would then be trying to build a sort of kiwi dinosaur, like a Tyrannosaurus Kiwi" – [STEM Mentor]***

Similar to the Experts, the Mentors also recognised the importance of creating a safe environment where there's no wrong answer: a space that empowers young people to challenge and question arguments and hypotheses, to develop their understanding and enhance their curiosity.

> ***"We know learning is inspiring when learners are asking lots of interesting questions that lead us to the next step of learning" – [STEM Mentor]***

There were also suggestions from all participants for developing and improving the initiative itself, including considering different ways of communicating in online and hybrid formats. It is important to note that many of the Visionaries continued to primarily consider physical and social aspects of the design. There is scope for organising more discussion *between* the school pupils (Visionaries) and college students (Advisors), particularly considering the cognitive aspects of design and exploring the different expectations that learners have about the new Dunfermline Learning Campus; by gathering together and working through these different views, there is the potential to create dynamic and inclusive spaces that inspire all different types of learning, including STEM.

6. Recommendations

Challenges and Stereotypes: There is still a lack of access to careers in STEM in terms of gender balance, and a lack of transparency about career pathways open to all learners, with evidence suggesting that views like "STEM is for geeks" and that "physics, engineering, and computer science are male-dominated" continue to be common. Visionaries accepted that perceptions need to be changed, through teaching and learning, with more positive messages that *STEM is for everyone*.

Skills and Employment: Learners must have opportunities to experience a greater depth of a particular subject or cross-disciplinary project-based learning before they choose to take it up in S3. Learners need ongoing opportunities in STEM, not just one-off events. The new learning campus itself could be a 'go to' Scottish hub for careers and employment advice and opportunities.

Inspirational Learning Spaces: Having a combination of open-plan spaces, classrooms, and places where learners can huddle or learn independently can support different types of learning. More consideration could be given over to designing a STEM learning Lab which, given the strong messages articulated by participants, should not be a replica of a traditional science lab in a classroom. Providing comfortable and agile furniture that can be easily moved to meet the needs of different types of learning activities was communicated, particularly by the Visionaries, as essential. Having more flexibility in the classroom would enable young people to have agency over their learning and in rethinking the environment to support rethinking STEM.

Influencing Change: The participants felt strongly that what makes STEM inspirational is providing equitable experiences, and creating innovative and exciting futures thinking spaces where everyone has a role and is valued. There needs to be consistency and momentum in promoting STEM to all learners.

Learner Voice: There is a need for further consultation with learners, with many ideas, worries and concerns about the new campus shared during the project. The schools are planning and organising for the architects to come in and gather perspectives from pupils, and this approach should be encouraged at all stages of development.

Connections: Evidence suggests that there needs to be a neutral space within the new campus, away from the classroom, that is designed to encourage conversations and connections between teachers and pupils. Holding a workshop with teachers about designing a space that encourages collaboration would aid with this. The campus will naturally bring together many learners (and teachers) of different ages and stages, and it is important that the potential for connections is realised through the design of the space.

Integrating different (learning) cultures: There are different learning and teaching approaches at school and college, and these differences need to be acknowledged and promoted in the new learning campus. A Learning Lab may offer new opportunities for sharing, learning, and collaborating. Likewise, it is important that different backgrounds, cultures, and experiences are reflected in a holistic way in the new design - learners and teachers should be able to 'see themselves in their environment.'

Shared Learning Design: There is scope for organising more discussion *between* the school pupils and college students, particularly considering the cognitive aspects of design, and exploring the different expectations that learners have about the new campus. Such community-building could involve gathering and working through these different views, to develop the potential to create dynamic and inclusive spaces that inspire all different types of learning, including STEM.

7. Further Reading

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