Could you begin by introducing everyone involved with Team Through My Window and explain how you all came to be involved with inspiring young people in STEM subjects?

I teach physics and engineering at Springfield Technical Community College (STCC). My commitment to broadening participation in STEM comes from my background as a non-traditional engineering student and from my work with underrepresented students at STCC.

Glenn Ellis (Principal Investigator) has taught engineering for many years at Smith College. A former physics and engineering teacher at a private high school, he has expanded his involvement with K-12 engineering education through his research into teaching and learning at Smith.

In middle school, Isabel Huff (Program Outreach Coordinator) had a wonderful experience in a STEM outreach programme. Through My Window has given her a way to give back to STEM outreach for girls and to help create positive experiences like the one she had.

Sonia Ellis (Writer) combines her background in engineering with her writing expertise to craft the rich narratives that are the hallmark of Through My Window. Imagining young people in STEM comes from her desire to change the perception of engineering for children who do not view it as a career that can change the world.

Al Rudnitsky (Co-Principal Investigator) is a Professor of Education at Smith College. His research interests revolve around teaching and learning for understanding. Math and science education at the elementary- and middle-school level are subject areas of particular interest.

Your team is intent on encouraging children to engage with engineering. What is it about current methods that make them insufficient when it comes to piquing students’ interest?

Current methods are often uninspiring. They don’t support deep learning, and they don’t present the breadth, complexity and creativity of engineering. Innovation is at the heart of engineering and what’s often missing is precisely what innovation and collaboration look like in real engineering.

The design process is typically the central aspect of K-12 engineering education but, unfortunately, it is often taught as a series of rigid, discrete steps to be memorised and followed. It quickly becomes obvious to learners that, while following those steps might lead to approval from the teacher or the production of a good product, it rarely carries the satisfaction of having learned something new, interesting and important.

Why did you decide to use the concept of Imaginative Education as a basis for developing your learning environment?

All children are able to learn deeply in a truly engaging learning environment. Imaginative Education, as developed by Kieran Egan, allows us to harness the power of story in order to create an environment that engages with children and gives them the motivation to care about what they are learning. Story is widely recognised as a proxy for understanding; if a child ‘gets’ the story they have necessarily taken a big learning step.

Imaginative Education also highlights the human side of knowledge. That is, ideas are invented by people to solve particular problems but they can always be improved upon. Human stories allow children to see themselves as participants in that type of world. Regrettably, these approaches are missing from most curricula.

Have you been able to utilise any emerging technologies in your project, especially considering your collaboration with the National Science Foundation (NSF)?

The learning adventures push the boundaries for educational software in terms of immersing children in story. Because discourse is such a powerful tool for supporting deep learning and the development of 21st Century skills, we are also particularly interested in getting learners to share and build upon each other’s ideas. We are doing this not only through our learning adventures, but also through the use of specialised software that has been developed for supporting knowledge building discourse communities.

What has been the response to this new learning environment so far?

The children who have used Through My Window are engaged, having fun and thinking deeply as they write down ideas. Educators see that Through My Window is very different from other engineering resources and most get very excited about using it. Some are nervous initially because teaching engineering – especially in such an idea-centred way – is unfamiliar.

However, when they discover that these ideas are framed in story that both they and their students can relate to, they become empowered engineering educators.
ENGINEERING IS RESPONSIBLE for a tremendous number of important inventions, innovations and discoveries, and the modern world is becoming increasingly reliant on the technological advances engineers have created. Moreover, as engineering becomes even more vital to our everyday lives and as the complexity of our technological dependence grows, there are increasing calls for engineering to become part of formal and informal pre-college education.

However, experts agree that this is not as simple as introducing a module called ‘engineering’ into primary, middle and high schools across the US – a subject that though intrinsic to a vast range of other subjects has traditionally been reserved for those in college or university. There are several considerations that must be made, including how to facilitate an understanding of engineering, motivate a desire in children to learn, inspire diversity in the field and instruct teachers on the best methods to teach engineering in meaningful ways.

FOSTERING THE NEXT GENERATION OF ENGINEERS
Responding to these calls, educators and students from Smith College and Springfield Technical Community College (STCC) have established an innovative project intent on engaging children and young teens in engineering. Funded by the National Science Foundation (NSF), the project is called Through My Window, and it targets groups in engineering that have traditionally been underrepresented, with a specific focus on girls. In enriching learners with knowledge of engineering, technology and literacy, the group’s aim is to provide relevant learning opportunities for all children, especially those for whom traditional STEM curriculum is not engaging.

Utilising two pioneering educational approaches, Team Through My Window has created a range of tools on two websites – one for educators [teamthroughmywindow.org] and one for learners [throughmywindow.org] – that aim to help and encourage children and young teens to deeply engage in engineering. The first approach is Imaginative Education (developed by Kieran Egan, ierg.org), which sparks the imagination of learners through the use of narrative. “We want to be the Harry Potter of STEM education,” Co-Principal Investigator Beth McGinnis-Cavanaugh enthuses. The second approach is knowledge building (developed by Carl Bereiter and Marlene Scardamalia, ikit.org), which emphasises collaborative online discourse to support deep learning and the development of knowledge age skills and innovative ways of thinking.

TALK TO ME
The Through My Window learning environment consists of three components: a full-length young-adult novel called Talk to Me; interactive online learning adventures; and offline enrichment activities. With an engaging storyline, the Talk to Me novel introduces engineering concepts such as artificial intelligence, engineering design and engineering ethics as well as diverse, relatable characters with strong female leads. It is available for free in English in an e-reader format and as an audiobook on throughmywindow.org. Soon, a free Spanish e-reader version will also be available.

Written by Sonia Ellis and illustrated by Evanleigh Davis [Lexile 860, 32 chapters, 144 pages] Talk to Me features 14-year-old Sadina...
Reyes, who is trying to solve a crime to stop her mother from being sent to jail. But, in order to do so, she and her friends have to help her little sister – who cannot speak – find a different way to share details about an incident she has witnessed. *Talk to Me* is a mystery novel, which, according to Team Through My Window, is the favourite genre of middle school-aged children. “Engineering concepts are so well woven into the narrative that they almost go unnoticed in places. However, the ways in which characters solve problems and resolve conflicts remind the reader that engineering is the key to the story’s successful outcome,” expands McGinnis-Cavanaugh. “It is the antithesis of a textbook.”

**LEARNING AS AN ADVENTURE**

The second component of the project is free companion online learning adventures, in which children join the novel characters to more deeply explore engineering concepts introduced in the novel in an interactive and immersive format. The first learning adventure, called ‘Rio’s Brain’, explores the limits of machine intelligence in the context of engineering. It opens with a graphic novel in which Rio falls off a cliff and wakes up in a hospital to find out that his brain has been removed from his head and will soon be destroyed. Rio – who is still receiving radio transmissions from his brain – breaks out, finds Sadina and together they track down the famous brain engineer Dr Ecks. Upon reaching Dr Ecks’ mansion, Rio collapses, and Sadina implores the learner to carry on and find a new brain for Rio. Learners then explore the mansion to find clues that will determine if an artificial brain can save Rio. They question things like ‘What is intelligence?’ ‘What tasks are easy and hard for machines?’ and ‘How do human and machine intelligence compare?’ Learners share their ideas about these questions in ways that are seamlessly integrated into the adventure’s narrative arc.

‘Rio’s Brain’ will soon be followed by two other learning adventures. “A learning adventure about engineering design called ‘Trapped in Time’ will be ready later this year, and an engineering ethics adventure will soon follow,” McGinnis-Cavanaugh shares.

**OFFLINE ACTIVITIES**

Through My Window also offers a third component – offline enrichment activities – that focuses on big engineering ideas and is designed to support *Talk to Me* and the learning adventures. The artificial intelligence activities, for example, allow learners to further explore ideas about the subject with engaging, real-world topics like machine consciousness, facial recognition, robots as caretakers and machine learning. “Broad, open-ended questions begin each activity. ‘Is reading emotions a particularly human form of intelligence?’ ‘Could machines ever have consciousness?’ Children discuss and improve their ideas collectively – they knowledge build!” impassions McGinnis-Cavanaugh.

**HAVING AN IMPACT**

At the end of the day, it is important to McGinnis-Cavanaugh and her colleagues that learning about engineering be meaningful and relevant to children and young teens and that their perceptions about engineering are broadened. Indeed, Through My Window appears to be resonating with its target audience, as demonstrated by both qualitative and quantitative examinations into their activities. “Educators tell us that this idea-centred approach appeals to a wider spectrum of children than does traditional curricula,” McGinnis-Cavanaugh notes.

This is extremely exciting news for the group, as they can see their work in the engineering field reverberating across K-12 STEM education in the US. The team upholds the belief that a focus on engineering has the potential to significantly improve the whole of this system. “Using engineering to bridge the gap between science, technology, mathematics and society brings meaning and real context to STEM education,” McGinnis-Cavanaugh explains. “It helps learners more explicitly see how these topics can be applied to help people. This helps learners develop STEM identity and makes STEM interesting and accessible to individuals for whom it previously wasn’t.”

**JUST THE BEGINNING**

With this initial success, the team has many future plans. For example, it is working on the creation of the project’s second phase, which will centre on a second novel called *Finding Sorrow*, scheduled for publication later this year. In this novel, readers will experience
knowledge building first-hand through the eyes of the protagonist. “It’s about young people who are players trapped inside an augmented reality game. To conquer the game and escape before their perceptions are altered forever, they will have to learn how to collaborate and engage with other minds trapped in the game. That is, they will have to become knowledge builders,” McGinnis-Cavanaugh points out.

With this second novel, McGinnis-Cavanaugh and her colleagues will develop five new learning adventures; topics will include bioengineering, construction, sustainability, flight and knowledge building. They will also develop a suite of offline activities to support the new novel and learning adventures. “Since providing resources to underserved communities is one of our primary goals, our resources are and will continue to be free, flexible and adaptable to any child, programme or classroom,” McGinnis-Cavanaugh states. “We are dedicated to seeing Through My Window significantly impact children who wouldn’t otherwise learn about engineering.”

With an engaging storyline, the Talk to Me novel introduces engineering concepts such as artificial intelligence, engineering design and engineering ethics as well as diverse, relatable characters with strong female leads.