Ep. 2 - The Importance of STEM Education: Start it Early!

00:08 Hello and welcome to the second episode of the SheCanEngineer podcast. In this episode, we will be discussing the importance of STEM education, what is being done, and what needs to change - particularly within primary education, and I am delighted to introduce our guest speaker Alexandra Knight!

00:26 Hi Alex! On behalf of SheCanEngineer, thank you very much for taking the time to talk to us!

00:32 Hi, thank you so much for having me, I'm really pleased to be here!

00:36 Please can you tell us a little bit about yourself and your amazing- or should I say 'STEMazing' career journey?

00:45 Absolutely, right where to start? Well, yeah - I'm a Mechanical Engineer background and the reason why I chose Engineering in the first place, going back quite while now- to the 1990s, was- well, I went to an all girls school and I was pretty good at Maths and Physics but they weren't my best subjects by any means. But actually a stand-in Physics teacher said to me once "you know, you should consider Engineering" and I thought "hmm okay I'm not sure about that". My dad is actually an Engineer, and, in a way, I wanted to do something different; I didn't want to do exactly what he did. But because I heard it from an independent source I thought "oh OK, maybe I should consider this" and he suggested I went on a summer Space school that was, I think, in between GCSEs and A-Levels and that was at Brunel University campus. And I just basically was hooked from that point. I thought it was, like, the whole idea of Space and using Maths and Science to help us explore the world and the universe was just like mind blowing to me, so I thought “this is definitely something that I would like to know more about”. So I did end up doing Maths, Physics, Chemistry for my A-levels even though they weren't, like, naturally my strongest subjects, but I felt like that career would make a difference. And from then I went on to do Mechanical Engineering at Brunel because I loved it so much at Space school, and yeah, kind of then specialised in Medical Engineering- I did a masters in that Imperial College. And then after that, went into a small Medical Engineering start-up company which was brilliant for, like, straight in at the deep end, like, everything from lab research, prototyping for different designs, through to clinical trials, pitching for venture capitalist funding, project management - like, it really helped me try out so many things and learn so much in a short space of time. But then I thought "there's so much of the world of Engineering out there that I don't know about" and I don't know what I want to, kind of, move into in my future career. So I decided to join a

consultancy - so I joined Frazer Nash consultancy, and really the aim for that was to be able to get a whole variety of engineering experience; so obviously in it consultancy, every different project you work on is like starting a new job in a new company, maybe even a new industry, new sector of engineering. And I got to work on some incredible projects from submarines through to designing wheelchairs for severely disabled children through to working with Paralympians at UK Sport through to working out in Thailand on an energy distribution project - so loads of amazing stuff and really, really exciting. And then I moved onto another consultancy- Amey Consulting, where I was working more on infrastructure in Civil Engineering projects. So as a Mechanical Engineer, you can still do so many areas of Engineering and I worked again on some really interesting projects- like around the combination of data science and analytics and technology with Engineering, kind of marrying up things like predictive analytics with Engineering infrastructure, and, you know, one of the stand out projects was definitely working on the digitisation of the Forth Road Bridge crossing in Scotland- and being able to turn that into essentially a smart asset that can tell us how it's feeling, you know, what loads it's experiencing and be able to sort of extrapolate that forward in terms of what to do with it with maintenance and operation. So really amazing projects- but I've always felt a burning desire, I suppose, to do more in the area of diversity and inclusion in engineering and STEM more broadly. So I have always done a lot of, like, voluntary work in terms of STEM outreach into schools and mentoring other women in STEM, and I was on the board of the Women's Engineering Society as a trustee for a few years, and I kind of love all that stuff and I feel like that's where I can make a big difference because I'm so passionate about it. And basically I've just struggling with splitting my time between too many different things and, as a mum of two kids and juggling homeschooling at the time of COVID lockdown, I kind of thought “right, what do I need to do in terms of simplifying my life to focus on where I can actually really make the biggest impact for me with my unique skills?”. And I decided that I would set up a not-for-profit social enterprise called STEMazing which allows me to do all the things that I'm really passionate about whilst, sort of earning enough of a living- I mean, certainly not compared to what I was earning in consulting, but enough of a living to be able to do that full time and so it was in 2019 - and then I actually left my day job as a Technical Director at Amey in 2020 and since then have been working on STEMazing full time.

06:25 Wow that’s amazing, that’s a massive leap! Your career journey or your background is really a great case example of how transferable engineering skills actually are, you went from Mechanical Engineering, Medical Engineering, working on submarines, wheelchairs and then digitising infrastructure which is actually really, like, that's really cool - you're making inanimate objects talk to you almost - which is a weird concept, but a really really great example of how we use Engineering to make the world a better place.

07:11 Yeah, completely agree - and actually that's kind of one of the things I tell other people if they are considering Engineering is that Engineering opens doors. It allows you to basically learn like a skill set in analytical approaches, problem solving, kind of understanding problems and coming up with solutions in a way that allows you to adapt and pivot your career based on what you love doing and what you find interesting. And there are so many areas in Engineering; I haven't even really scratched the surface in all the projects I've been involved with, which is still being a lot, so yeah - that's one of the things that makes me so passionate about it - it's just the variety and the number of opportunities available to everyone to be able to make a difference doing something that they love.

08:05 I completely agree, that's one of my favourite things about Engineering - it's variety, that I'm never bored in Engineering, I get bored- I wouldn't say 'easily' - but I like to challenge myself and there's always something new to learn within Engineering.

08:22 Absolutely, completely agree.

08:25 So going back to what you were saying about school and how it was actually a Physics teacher who gave you, almost, the idea of perhaps looking at Engineering as a career. We spoke to Dawn Bonfield in the last episode of the podcast about the pipeline into Engineering and we focused the conversation more on the GCSE and A-Level ages and upwards, and how there are challenges. Firstly the barriers there in getting into, sort of, University, in Engineering and we touched a little bit about how actually more needs to be done early on in the pipeline. So when we look at the primary schools, how do we explain to primary school children that STEM careers, and I suppose our particular focus is Engineering, are really great and how do we get them interested, and how we keep their interest. So, you know, it's all well and good telling a 7 year old Engineering is great but between 7 and 17 there's a lot of years there, so how do we keep them interested and enthusiastic and motivated? I know that you do a lot of stuff with STEMazing with primary schools so would you be able to explain the sorts of activities you get up to with primary schools?

09:51 Yeah, so, I mean, the reason why I focus on primary in STEMazing is because when I was first setting up STEMazing, I was really kind of looking at, you know, there is so much that needs to be done in education at all levels to raise awareness and aspirations particularly with regarding STEM careers. But I was looking at where I felt I could make the biggest impact and looking at some research papers, what kept, sort of, jumping out at me was the amount of gender stereotyping that happens with young children, and especially with regards to careers and what is a boy's career and was a girl's type career and the fact that this happened so young, you know, by the age of like 7 years old, kids already know or they've already decided

“right, that's a man's job and that's a woman's job” and they can sort of like distinguish between them. And it's something that I thought this is we need to tackle it at this early stage and more research showed that the importance of visible role models encounter typical careers are really really influential at a young age for kids so I thought “right, knowing that I've done a lot to, like, help women in their STEM careers be more confident and kind of mentoring and coaching them to bring their yourself to work and feel more confident in their role to speak up in meetings and go for promotions and stuff like that” - I thought if I can combine that work with outreach into primary schools to give primary schools more visibility of women in STEM as role models then that would really help. And not only that, but exactly what you were saying about how do you really engage them and leave a legacy, leave a real impact, something that lasts longer than just a quick talk that they like in the moment, but then they forget about. And so I came up with the idea of doing like a series of what I called STEMazing Kids activities which are targeting early primary school age so kind of like Years 3 and 4, really so age, kind of, 7 and 8, and we make them really interactive really hands on so it's not a presentation. It's not a talk, it's a hands on activity where they explore certain a science or engineering principle through a practical hands on interactive activity and they actually create something themselves that they can take home to continue to test, continue to improve, talk to their family about it. Not just do it once, so all of our STEMazing Kids engagements are like at least a series of a few activities and in my Inspiration Academy that I run, where I match up women in STEM with primary schools, support women in STEM to be more confident on camera because we do it via Zoom. And then they deliver STEMazing Kids sessions into schools and that's a series of six, so six weeks and again - the research shows that a one off session doesn't really have a lasting impact but if you repeat and, kind of, do it for at least a month, if not longer, then that leaves a much more lasting impact and legacy with those children in terms of them feeling like STEM is fun. They understand what STEM is, they understand what kind of STEM jobs are out there, they’re tangible to them so they can relate it to their real world and their real life. They see a woman as a role model which, by the way, is important for girls obviously - but also important for boys because unconscious bias is set in at such a young age, so we want boys to see women in professional STEM roles and to see that as normal. And yes, so we've had quite a lot of -well - fantastic, really, response from schools taking part in these initiatives, and also the women taking part saying they love it and it's boosted their confidence which has also a number of added benefits in the STEM workforce. So I'm kind of continuing to grow that and continuing to have a focus on that primary school age - hands on, interactive activities, lots of relation to real world stuff but very practical so that kids actually get engaged and stuck in because I think that is really what grabs the attention of young people; I know through my own children as well, will hopefully leave that lasting impact.

14:39 It must be quite difficult to sort of get across what Engineering itself is because I guess kids at that age - they kind of understand what Maths and Science are because that's stuff they learn at school isn't it - they're actual subjects you learn at school. It must be quite difficult to then show them what Engineering is when Engineering isn't a subject that they learn as such. So how do you, through STEMazing and your Inspiration Academy, portray Engineering - compared to other aspects of STEM, because, like you said there's lots of different fields within engineering as well. And it's a minefield trying to, I guess, showcase them all because it will be near impossible to showcase all the different fields within Engineering - but how do you then relate what they do at school with Maths and Science to then show them what Engineering is.

15:44 To be honest, people ask me this quite a lot and I don't think it's that difficult because you just have to show them the connection between Maths and Science that they see as two separate not connected subjects, and problem solving in the real world. So the activities we do, for example, with making different shapes of paper towers that I did once for a SheCanEngineer activity a couple of years ago is really simple, fantastic activity to show the importance of shape in design, and we talk about different shapes and structures in buildings that they'll see all around them and we can therefore relate Maths and geometry - so shapes of things - to real world examples of how a Civil Engineer or Structural Engineer will design something that will be strong enough,, that will stand the test of time. And we talk about different structures and so I feel like it's just a conversation that needs to be part of the activity is almost like just saying, asking the children what different shapes do you see around you- like, shapes is part of work that you'll do in Maths and how strong something is that's related to its material which is related to your Science that you do - whether it's solid, you know, liquids. We talk about different types of structures and then we relate that to the real world and get them to start looking around them and being curious as to why things look the way they do or, you know, how things work or why they’re shaped like that and so I think it's, as Engineers we just have to remember to, kind of, break it down to the most simple tangible explanation of what Maths and Science is used for in the real world. And we do a number of different examples about everything from making little paper rockets and talking about forces and propulsion, through to making lava lamps and talking about chemical reactions and liquids and gasses, and,, you know, just make it fun! But also make sure you get in there how it’s relevant to the real world. And then, you know, the beginning of this series of sessions, you've got the majority of the class have no idea what the 'E' in STEM stands for. Some kids would guess at ‘English’ then so they've definitely not heard of Engineering as such, as a subject, and by the end of it, they can tell you what different Engineering careers are out there and what Engineers do in the world and how they make a

difference. I find that kids, even at that young age, understand the problems we are facing in the world. They care about the planet. They understand, like, we've got problems with climate change, and plastic pollution in the oceans, things like that, and they can relate the fact that Engineers come up with solutions to these real world problems and that's what we're aiming for.

19:03 Yes, it's really good, you know, just within one session not know what Engineering is and thinking that it's and the ‘E’ stands for ‘English’ and actually being able to distinguish the different types of Engineering- that's that's really really great, really positive, that's a real positive impact that you're making to the kids and if, you know, carrying that sort of momentum -

19:29 Yeah and I think it's also not just the kids; like, sometimes the teachers are learning just as much as well. And obviously then they can continue that conversation and we've worked in primary schools where they had no idea what STEM was they didn't know what STEM even - the teachers didn't know what STEM, like, stood for. And they have now introduced STEM weeks in their primary schools, and they come back to me and ask if any of my STEMazing women can help out in those, because they were inspired themselves to keep doing it - which is brilliant. And the other thing is that we don't want it to stop just with the kids, we want them to go home and have a conversation with their guardians, their parents, their siblings and help spread that message as well, so after each of our STEMazing Kids sessions, we give them a completion certificate which sort of says what they did and the key STEM messages so they can take that home and be proud of it, and talk about it so we're trying to spread the message as far and wide as possible.

20:34 It's definitely really important to educate and inspire teachers and parents and guardians, carers, all the, sort of, key adult influences in kids' lives. My background, my parents and teachers, they didn't know what Engineering was either. They had a perception of it and the perception was, you know, it was a 'Mans job' and that it's not something I should really consider and my story kind of starts a bit like yours- because it was a Physics teacher who introduced the idea of Engineering to me. He was a brand new teacher to the school and until then, I thought I'd maybe want to be a pharmacist - but I wasn't sure. I knew that I liked Science and Maths; I was good at them at school, so I thought I'd do something related, and yeah it was a Physics teacher who said “oh maybe you'd want to consider Engineering”. But my parents on the other hand, they still had no clue, and even though my mum has always been happy for me to follow my path, I think she did have her reservations about me being an Engineer. And it wasn't until a couple of years ago, I took her to the Royal International Air Tattoo and there was a STEM zone, primarily aimed at kids, and my mum really got into the STEM zone. She was putting on the, you know, the VR headsets, doing all the puzzles that the kids would do, building stuff with the, sort of these, almost like Meccano and Lego and stuff like that, and finding out about my world in

Engineering and ever since then, she's been a real advocate for Engineering - for everybody. She's telling everybody that Engineering is fantastic and more people should consider it. And it's just changing, you know, that sort of, perception of it. You know, she went from saying "oh, I'm not really sure it's for you", to being like "everyone can do it!"

22:51 That's amazing! And you know, maybe if someone had told your mum about STEM and Engineering when she was younger, she would've been an Engineer, but of course, yeah, it just needs someone to almost, like, flick a switch in your brain to even say this is an option. And of course we're not trying to say everybody who gets involved in STEMazing kids has to go on and do STEM. But what we are doing is hopefully showing them that it's an option and if they do feel interested and want to pursue STEM subjects later on and go into STEM, then that's fantastic and there will be a place for them, and- but those who don't, at least they will also awareness of what it is and hopefully grow up to kind of, you know, at least have a conversation with maybe their own children one day about what it is. So we just need to do, like there's so much work to do and we're just, again, like just tackling one tiny area of it, but so much work to do to raise the awareness of STEM, and particularly Engineering in society as a whole because I think if more people knew what it's really about, a lot more people would choose to go into that kind of career.

24:03 Yeah and you're right, there is a lot of work to do but we can't tackle it all at once and if we're taking on little chunks- I mean I wouldn't say that what you're doing is a little chunk, I think it's actually a massive chunk of work. but it's all- it all adds up and it does, it does make an impact. And I guess on the subject of making an impact and leaving an impression, you've been involved with SheCanEngineer, supporting our events, for a number of years now. Last year was the first year we opened it up to primary school ages through the competition and we had the theme of Engineering superheroes, and the primary school and secondary school students were asked to submit their designs of who they think would be an Engineering superhero, in their their minds what an Engineering superhero could do to solve a couple of problems, and you actually announced the the winners for us last year. But from the previous support that you've provided us, someone actually found you and is now enrolled in your inspiration Academy!

25:20 Yeah, absolutely - so I just- I literally heard this morning! I was having an email conversation with one of the women on the Inspiration Academy programme and she just said "oh by the way, I thought I should let you know that I actually found you when I had watched a session that you ran making some paper towers" - the activity I mentioned before- and she loved it, she said she'd watched that as an adult, like, to get involved and get ideas for STEM outreach and she loved the idea and has since run it with a couple of different brownie groups and they all really loved it. And then that kind of introduced her to me and STEMazing and then

later on, so like at least a year, if not longer, later she enrolled in the Inspiration Academy so is now building her confidence and doing even more STEM outreach which is fantastic. And so yeah, it's amazing how, kind of, you know, different initiatives maybe a targeting like slightly different things and have slightly different objectives - but they can all support each other and actually it's important to remember that anybody working in this space of, sort of, inspiration and inclusion in STEM - there are so many opportunities to collaborate,and kind of amplify our impact by working together and supporting each other. Because it's certainly not a competition and not, you know, there's so much work to be done that there's enough for everybody to really make a difference. So I'm really pleased to keep the collaboration going with SheCanEngineer and also appreciate all of your support, thank you!

27:02 Well we appreciate everything that you've done for us in supporting all of our events - we love having you on!

27:12 I love getting involved with what you're doing because you're genuinely, like, you know, you're - it's such a lovely group of people working on this. And you're obviously genuinely so passionate yourselves, which really comes across, so it's fantastic to be involved in it.

27:27 For our listeners who have listened to you speak and actually think that they might want to get involved, first of all as a STEM ambassador, do you have any sort of, I guess, advice and tips for engaging the younger groups? I think we have a lot of, almost, advice and support in sort of, targeting GCSE and A-Level groups, but again, focusing on primary school, I think when we go into schools, sometimes we can struggle because we're not used to, as STEM Ambassadors, we're not used to speaking audiences that young.

28:19 And I think it's a really good question because you do have to think about your audience when you are presenting and essentially, when you are presenting or doing a talk or running a STEM session, you are, in a way, performing. You are there to, kind of, inform and inspire and influence, in a way, your audience. So it's really important that you consider the audience that you are presenting to, and tailor how you're saying what you're saying appropriately. And I feel like for primary school kids, unless you've got your own children or grandchildren and you're used to dealing with younger kids, it can be quite daunting. Because, you know, they've probably a lot more high energy, so they might be, you know, they're not just gonna sit there quietly and listen to you for ages - and so I would say like anything you can do to make it as interactive as possible and engage them, you know. Running an activity is absolutely perfect, and spend more time on the interactive activity than on just being on, sort of, transmit-receive mode where you're just talking at them. And make it tangible to their level -so what is going to be relevant to them in their world that you can relate Engineering to, and don't over complicate

things but also you don't have to oversimplify it, You know, you can talk to them about some some big real-world challenges that we're facing and how Engineering is making a difference in those. And one of the things that I find, you know, I always give this advice and it's something that we do we concentrate a lot on in the Inspiration Academy - is your communication style and how energetic and, kind of, motivating you are as a speaker, as that role model that they are looking up to. So getting a bit of practice in not just what you want to say, but how you say it and even better if you can record yourself doing a bit of your session, like a bit of the talk or even running an activity and then watch it back and almost critique it yourself and give yourself some feedback for improvement - because I feel like, you know, we want to inspire the children so we definitely come across as matching their energy level. And I'm not saying you have to be like, you know, a seasoned children's TV presenter, but just actually spending some time thinking about your communication style will make a massive difference in how your audience feel at the end of your session; you know you want them to feel inspired, motivated and uplifted. They'll remember that more than exactly what you said.

31:23 And anyone who is looking to get more involved they can pick up more tips and guidance by joining your Inspiration Academy.

31:34 Yeah absolutely! The Inspiration Academy is free for women in STEM to join. You can find out more on my website which is stemazingltd.com and there's a tab called Inspiration Academy so check that out. I mean, I am always looking for sponsors to support it because that helps us keep it going, but we make sure that we keep, like, a good number of spaces free for any women in STEM at any stage of their career to apply to come on. And also free for any primary schools to take part so also spread the word with primary schools so that they can get involved but yeah we do a lot of, like, basically supporting the women initially and then going into the schools. And I'm so pleased that we have such a diverse range of women getting involved because we want to showcase diverse role models- and one that really stands out to me at the moment is that we've got a deaf woman who works as an Engineer in a water company, and she applied to come on the programme. And I didn't know initially how well that was going to work, but we've had conversations about how to help her with things like our live webinars, and she has a translator come on and do sign language for her. And she is now delivering the series of STEMazing Kids sessions to a primary school that are hearing impaired, so a hearing impaired class of children, and she's doing it all in British Sign Language which is just incredible! It blows me away, like, it's just so brilliant that we're reaching a whole range of children that otherwise you know maybe wouldn't get this kind of opportunity.

33:14 Yeah that is incredible! And intersectionality of diversity is another huge huge topic which we don't have time for, but you're right, you know, representation really does matter; those

visible role models really do matter, and I've had quite a few students come up to me afterwards and say, you know, as an ethnic female, they never really considered it, but ‘oh you're an Engineer that looks like me’ and, you know, just hearing stuff like that is like ‘yeah, actually that's what I'm here to do’.

33:54 Yeah completely. And if it's just one person at the end of the day that you have opened their eyes to a career that could be you know the perfect career choice for them, otherwise they wouldn't have considered it, then as a STEM ambassador you've done your job. So, but you know, generally I think even kids who maybe won't go on and do STEM careers, they are still- it's opened their eyes to the possibility, maybe helped raise their aspirations to exploring other opportunities and so yeah, never underestimate the impact and the difference you can make as a STEM ambassador - it's such a fantastic thing to do.

34:34 I think that’s all we've got time for really. It's been really really lovely speaking to you; you are such an inspiration, you've inspired me - previously and just in this podcast, I think I might sign up to your inspiration Academy!

35:03 Yes, do that - I'd love that Laura! Yeah that would be amazing, I'd love to have you on board.

35:07 Thank you very much, Alex, for giving up your time for this podcast but also for all of your support with sSheCanEngineer, it's great having you on board!

35:19 Brilliant, well it's been an absolute pleasure, thanks so much!