Shaping Education; Creating Australian Scientists

By Chloe Kwan

Many, I imagine, cannot remember their primary school scrapbook, containing leaves and scribbled notes colourfully detailed in gel pen with the title "Science". However, lucky or not, I can. I'd like to play it out and cover the truth, but I have to say; I absolutely hated Science. Even for reference: if I quote from my bright pink *Hello Kitty* diary, I wrote "I hate science, it's so boring". Even a snappy message from my eight-year-old self detailed a very early and very fervent hatred of STEM subjects. Which poses the question, How does a child who, quite frankly, was told off continuously for asking "why?" and "how?", express such hatred for science? And not only that, but so early on in their schooling career? This growing disinterest has followed us throughout our childhood, as we grow up, and now, as I enter year 10, I see my peers' curiosity about the world slowly dwindling and disappearing. The sad part is, I have since realised, that curiosity and science is not slipping away now - many people began losing the reins from the moment they entered the education system. This has been mentioned and studied time and time again; revealing that a key issue holding us back from our future is stimulating an interest in science and technology. This is not a mistake or an outlier, it is a clear issue that needs to be studied, understood and overcome. So, let's go back in time to a place far, far away: primary school science.

This is where we must begin, and ask "why?". As an experiment, let me ask you to picture a scientist. If you're anything like the general population, you picture a genius, maybe an old white man with spiky hair and funny glasses. This is not uncommon, but if I were to ask everyone to picture a scientist, how many people would actually picture themselves? The truth is, at heart everyone's a scientist; we are born scientists. Yet the education system doesn't allow children to see themselves in science, or in the lab, in any shape or form, especially in primary school. In fact, research from the University of New England shows that 78% of year 10 students said that they prefer secondary school science to primary school science; often because it's an actual subject which you can fully learn, study and understand; treated with equal importance to English and Maths. Picture primary school science. For many people, I'm sure they can't. Even for me, when primary school was only 4 years ago; I remember much more about basically every other subject. And even then, science only consisted of little household experiments with easy-to-get materials like shaving cream and water. The 'Education Matters Magazine', a highly reliable news source for decision-makers in the education system, states that resourcing is one of the biggest barriers when it comes to teaching science in primary schools "Many schools have limited stocks of science equipment so teachers constantly make-do. Re-used cups become beakers, and plastic plates become petri dishes." I have personal experience with this lack of resources. I can clearly remember in kindergarten when all 30 children were wrapped around a jar of food colouring and shaving cream, and whilst I would love to tell you what we were learning, I don't remember. What I can tell you though, this 'experiment' was not performed in a lab, the amount of water was not measured, the amount of shaving cream was not measured, and the amount of food colouring was not measured; not that we even had a measuring cylinder in the school anyway. Let's just say, I remained uninterested, confused and even if I had asked to see it again, I couldn't. We didn't have the resources to do it again; the same bottle of cream and the same food colouring was shared between all 5 Kindy classes. By the time I had to write down what I saw, I stared at a blank page, the jar was gone, the experiment I didn't see, and the lesson I didn't

even understand. And yet, Year Six's disinterest in in-class science experiments always seems unwarranted and 'strange'. Well, this lesson was learnt in kindergarten, and time and time again through primary school. You cannot get children interested in something that doesn't even work.

Expanding further, there were never multiple trials, experiments were never repeated, and the same lesson was never mentioned twice. This harsh reality damages the efficacy of these experiments and does not demonstrate these three basic principles: validity, accuracy, and reliability. If you're unsure, let me quickly define these terms: validity is when something measures the right thing, like if you were measuring your mass, you would not be measuring your height. Accuracy is how close it is to the true value and can be determined by using the right tools; using the example before, if you were measuring your mass, you would use a scale, not a seesaw. The third is reliability, this is how many times you can get a similar value by repeating the experiment, for example, you would assume there's a glitch in the measurement if you measured your mass to be say 60 kilos the past ten times but then 300 kilos on the eleventh. This lack of repetition and equipment essentially throws all of these out the window, children aren't getting accurate measurements, rendering the experiments unable to be repeated and unreliable. We weren't promoted to see one of the key parts of science and scientific observation: the pattern. An article published by NRICH, Cambridges' mathematics enrichment project, states that "Australian researchers, Papic, Mulligan and Mitchelmore (2011) have recently found that pattern awareness can be taught effectively to pre-schoolers, with positive effects on their later number understanding." Whilst they are talking about skills in mathematics, the same article also states that this pattern recognition builds key skills in identifying relationships between elements and observing irregularities; skills that are highly desirable and necessary in fields of science. However, oftentimes in our early education, this need for pattern recognition is ignored, leading to key gaps in knowledge surrounding theories in high school and beyond. This puts children in a compromised position, behind before they even start, leading to this feeling of one step forward and two steps back. This gap in foundational knowledge and lack of development in pattern recognition, especially in science, will ultimately hurt their progress, and many will choose not to try again. Many of my peers can attest to this. One day, you are thrown into the garden and the next you are looking into space. There is little repetition and you seldom encounter the same phenomenon twice. Many researchers rave about spaced repetition and study skill experts often shove it down our throats, but why has this not been applied to early education? Even scientists at Birmingham university have stated that the 2357 method (a method where you revise the same content 2,3,5, and 7 days later) is a great way of training your brain to retrieve information and remember it over a longer period of time. We are not doing this, causing science lessons to be forgettable and irrelevant over the course of just a week. And yes, whilst it's important to show the scope of science, and I recognise the lack of time primary school teachers have, this lack of consistency and repetition has forced on us one horrible image of science - that it's forgettable, inconsistent, and irrelevant.

This leads smoothly into the next issue surrounding teaching primary school science: there just isn't enough time. In the magazine article that emphasises the lack of resources, the authors also include time; stating "the time to prepare resources would be amongst the top barriers for many primary teachers". Looking further into it, the NSW K-6 time allocation advice shows 6-10% allocation for science until 2027 and a new allocation of 8% for the reformed syllabus (the actual time however is averaged at around 3% (45 minutes)). Whilst the allocation is still around 2 hours in a 25 hour week, research from the University of Vermont states that the allocated time should be at least 5 hours of science learning, indicating that; " without at least 5 hours of instructional time dedicated to science during a typical school week, teachers are less likely to use the types of inquiry-based learning practices recommended by leading science and education professionals." This is at least 20% of the weekly hours in a standard week of schooling; the same metric for maths, to which guidelines also allocate at least 20% of the school week. The two hours that are currently prescribed are just not enough, especially if teachers are trying to incorporate time for planning experiments, organising resources and cleanup. Adding these all together, I doubt children are getting more than around 40 minutes of time actually participating and engaging in science investigation. Tammy Kolbe, an associate professor of educational leadership and policy studies at the University of Vermont states that for many teachers who participated in this study, "Even the best teachers are less likely to teach inquiry-based science if they don't have the time". Time is one of the most important resources when it comes to learning, and if we are truly trying to get children to be interested in science, we have to give them the time and the exposure. Without it, the children aren't learning the

content, and they also aren't learning the practical and investigative skills that science classes should give them. They are learning that they don't have time to think, they don't have the time to be critical, they don't have the time to do 'this'. While it seems insignificant, it takes away the time and effort children use to build one of the most important parts of learning, critical thinking. Children are learning that thinking takes time, and time is limited, creating followers, robots and taking away a part of our humanity; the way we see our world, not just the world. Our unique perspective that we derive from observation, and thinking, not just believing. Without addressing this lack of time, we are not ruining science, we are ruining education. We are taking away children's ability to think for themselves, and we are creating safe-thinkers, not world-changers.

We need change in our methods, and also in who is teaching. Primary school teachers, I admit, have it hard. They need to teach the whole curriculum and to do that, they need to learn the whole scope of the curriculum. They then need to squeeze it all into a 25-hour week! I am forever amazed at their hard work and dedication to their students. However, many teachers regard themselves as having difficulty teaching science and agree that more support should be provided. In a survey conducted by James Deehan, a professor at Charles Sturt University: out of 165 primary school teachers, 47.27% of participants agreed that 'further professional development would be a huge asset'. To become a teacher, you must learn. In research done by Drs Fitzgerald, Dawson and Hackling, a primary school teacher Deanne stated, "To assist with preparing students for learning about science beyond primary school, teachers may need to develop their own scientific knowledge.", often taking out her own time to research scientific topics to better understand them. Many primary school teachers have similar struggles with limited knowledge of science and discuss their difficulty to properly communicate sophisticated ideas, especially within the fields of physics and chemistry. This large hole in their knowledge, not only affects the teacher's confidence and reliability but also the children's interest and knowledge about science. This continuing trend of children straying away from physics and chemistry is also evident in 2025 HSC data where only 18,000 children took physics and chemistry combined compared to 20,000 who took biology. Even in my recent experience, I spent three years learning why leaves are green. Yes, I can tell you about chlorophyll, but why did I have to learn about sound waves after school from a YouTube video? This has followed children throughout the years, as year 7 teachers struggle to fill the gaps and students fall further and further behind in their studies. Drawing from my own experience, I felt like I knew nothing when I entered high school science. Every topic the teacher would ask "your primary school teacher would've spoken to you about this yes?" and thirty girls would shake their heads, in a solid, unsettling, no. This isn't just an individual problem, this is a problem across different suburbs, different schools, different schooling streams. My classmates had come from all areas of Sydney and the one thing we found in common was not our hair colour, or interest in a rock band but a big, gaping hole in the subject of science.

However, I do not wish to end on a negative note. In the next 10 years we can make a larger improvement than we've seen in the past 20. Almost all these issues within science education can be resolved, and there is so much hope. Strategies and emphasis on science can shine a light for students around the state, the country, even the world. The most beautiful thing about this issue is that we can overcome it with the proper tools, understanding and voices, and with these we can bring science to children and bring up a generation writing "I love science! It's so fun" in their bright pink *Hello Kitty* diaries.

More resources and funding can be allocated for science teachers, especially in primary school. Schools have started incorporating more into their science classes and in a not so far away future, maybe even primary schools can have their own labs with proper safety precautions. How awesome would that be? A bunch of 6–12-year-olds being able to use an actual science lab and see themselves in a white coat and safety goggles. They'd gain hands-on experience of scientific procedure and would have access to real equipment! Addressing issues within science funding for primary schools would allow for children to gain not only scientific knowledge but skills that can be used across the board - asking questions, searching for answers, and using evidence to drive conclusions. Even a wet room in classrooms is better than nothing, as more primary school classrooms began to have taps and areas to get messy during my time there. I was able to see a clear difference from my time in kindergarten compared to year 4. As we moved to more modern classrooms with special 'wet areas' covered in lino floors, spillages were easier to clean up and

teachers were more likely to allow us to independently experiment even if it was just with jars, oil and water. Why? Because there wasn't an issue with clean up time or fear of damaging the classroom. I was able to see it myself, to do it myself, and I wasn't the one watching the teacher do it, I was the one doing it. That was our lab, but imagine what it would be like for children to actually have a whole room to get messy and truly engage. These resources would make our teachers, students and parents all happier. Children would be able to see what affects their experiments, what works and what doesn't, and how to recognise patterns! Teachers would not have to spend money from their own pockets for resources, and experiments can be repeated until it's understood and until the data stands. Even Professor Buckingham through the Royal Society of Chemistry states " We need to ensure that all pupils are exposed to the excitement and increased understanding of science that carrying out practical work can bring." This could help to bridge the gap between science and students, allowing for more children to actually enjoy it and participate, even if they don't choose to pursue it as a career.

These resources also include opportunities, competitions and initiatives that can interest and involve children in science. Whilst there are many already, schools aren't as involved with these as with English and Maths and they often remain unadvertised. As I went through primary school, we were promoted to participate in school-wide speech competitions even from kindergarten, and through stage two, we were introduced to advanced maths classes and the maths Olympiad. In research done by James Deehan, there is a clear lack of childhood initiatives for science: "Indeed, a *STEM Education Initiatives Synthesis Report* provided to Australian education ministers in 2021 included only one early childhood initiative out of 69, equating to just 1.5 per cent!' Even looking through a simple Google search, most science competitions and initiatives are aimed towards high school students who are already interested in science. By beginning the exposure of these initiatives earlier and having more opportunities for primary school children, we can foster an interest in science which can carry through high school and beyond, outside of the classroom. Through these programs and initiatives, we give children an avenue to explore further, develop more skills and see what science has to offer. By challenging their practical and investigative skills, we could improve the fundamental parts of becoming not only a scientist, but a more critical thinker and learner. Without these initiatives, we promote the notion that science is insignificant and unimportant. If we don't see something outside a classroom, we don't see a need for it in our lives. Science should not and cannot become background noise. Increasing these opportunities and initiatives and more marketing towards them could make a world of difference in how children perceive science and allow them to understand how it applies to the fabric of the world around them. They'll be able to see themselves there.

To foster a real interest in science, a very real and very important strategy that we can include in science classes immediately is actually mentioning how science branches out into other subjects. From experiences around me throughout science education in the present day, my friend (who we'll call Person X) was genuinely uninterested in science, dozing off in class and continuously asking me how I found 'this stuff' interesting until our physics unit on sound and light where they basically lit up because it was related to something they were interested in and passionate about. There's even a quote from my other friend which says "Person X started talking about how interesting and cool science seemed after spending 3.5 terms talking to Person Y and doodling" This switch up isn't a coincidence, it comes from a place of interest and if teachers can expand on how science contributes to so many other parts of the world, not just quantum mechanics and flowers in a field, we can get so many children to realise that they aren't "stupid" or "not fit for science" but they are just different kinds of scientists. This would not only allow for more children to choose science as a subject, career and interest but it would foster life-long skills that transfer to every other field – experimenting, questioning and actually thinking. If this variation in topics occurred in primary school, we would be allowing not only the scientists to bloom but also every other musician, soccer player, poet, and artist to blossom in their own right, using knowledge that they learnt from science to transfer into their own beautiful careers. Just how amazing is that? Teachers would be speaking to every child, not just to the 'nerds' who listen. We could finally have a world where if I asked someone to picture a scientist, they would without a doubt, picture themselves.

We are making Australia as we speak, we can make the young scientist of Australia greater than you or me, and these steps and initiatives will surely accompany many throughout their lives, making every cook, writer, musician, sports player, and scientist better. Through these strategies and identifying key issues, we are building universal foundational skills for all of our children; creating critical thinkers, world leaders,

and ground breakers. Let's have the writers know why the syllables matter, the musicians understand sound waves, the soccer players understand the physics of their kicks. Making science accessible and integrated is what keeps science alive – outside of white coats and labs, it's what keeps science in us and what can keep science in you.