Growing curious minds: Student and Teacher narratives about using House of Science Resource Kits

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FOOD & FIBRE CoVE
Learner-Focused, Industry-Led, Government-Enabled

This research was undertaken by Dr Lesley Petersen, with funding provided by Food and Fibre Centre of Vocational Excellence.

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DISCARD AFTER USE

EXECUTIVE SUMMARY

House of Science (HoS) is dedicated to promoting scientific literacy among New Zealand's youth. Recognising the pivotal role educators play in this vision, HoS has been actively enhancing teacher confidence in teaching science through professional development initiatives and by providing comprehensive science resource kits (kits). These kits are crafted to offer students engaging and interactive science lessons.

An opportunity arose to understand the learning impact of the HoS kits on students and teachers, and Food and Fibre Centre of Vocational Excellence (Food and Fibre CoVE) were engaged to undertake an exploration of this influence.

This project, adopting a case study methodology, examined the impacts of these kits on students' educational experiences. It explored the influence of the kits on students' decisions to continue with science subjects as they transition from primary to secondary school and their inclination towards considering a career in a science-related field. Additionally, the study also examined the effects of these kits on increasing teachers' confidence and skill sets, especially in handling student inquiries effectively and stimulating scientific discussions.

The insights and major themes presented are narrated through the experiences and stories of both students and their teachers. The primary objectives of the project were:

1. To assess the impact of HoS resource kits on primary and intermediate school students' choices to choose science subjects at secondary school.
2. To discern if the kits influenced students' future career aspirations and their experiences with science during their primary and intermediate schooling.
3. Discover whether primary and intermediate teachers have gained confidence and skills in teaching science because of the kits and teacher support provided by HoS.

The stories and findings from this project show how influential the science kits are in shaping students' learning and in changing how teachers approach science education.

INTRODUCTION

House of Science's (HoS) mission is to foster scientific literacy among New Zealand's youth. Recognising the foundational role of educators in this endeavour, HoS is committed to enhancing teacher proficiency through professional development programs and the provision of comprehensive science resource kits. These kits are designed to facilitate interactive and captivating science lessons for students. Using a case study approach, this project explored the impacts of these resource kits on students' learning experiences, their decisions to pursue science as they transitioned from primary to secondary education and beyond, and their interest in considering a science-related career.

The case study also investigated what has happened with teachers' confidence and skill development in encouraging primary and intermediate school students to pursue science at high school and beyond, after using the kits. The findings and key themes outlined in this report are told through the narratives of the students and their teachers.

(i) Project Aims

The primary aims of the project were to:

1. Determine the influence of HoS kits on primary and intermediate school students' choices to undertake elective science subjects at high school.
2. Identify if students changed their future career/employment choice because of the kits and their experience of learning science at primary and intermediate school.
3. Discover whether primary and intermediate teachers have gained confidence and skills in teaching science because of the kits and teacher support provided by HoS.

(ii) Background

WHO IS HOUSE OF SCIENCE?

House of Science is a not-for-profit organisation dedicated to raising scientific literacy among New Zealand's youth. Their overarching vision is for every child in the country to be scientifically literate, understanding science concepts and processes they encounter in their daily lives. Their mission is to empower teachers with the tools, resources, and professional development opportunities they need to deliver comprehensive and stimulating science lessons.

FUNDING AND PARTNERSHIPS:

The development and maintenance of these kits are made possible through collaborations with science organisations and government, including the MacDiarmid Institute, Ministry for Primary Industries, and AgResearch to name a few. Local sponsorship plays a pivotal role in funding the upkeep and delivery of each kit. This collaborative approach ensures the kits are not only educational but also relevant, tapping into the expertise of leading science institutions.

THE SCIENCE KITS:

Central to House of Science's approach is their science resource kits. These kits are designed for Year 0-8 students, offering hands-on experiments to make science lessons interactive and engaging. They are fully aligned with the New Zealand curriculum and come with te reo Māori and English student instructions and a teacher manual. Approximately 15 percent of HoS's 645 member schools are full immersion kura. The bilingual science resource kits are used by 30,000 students each fortnight. Using a subscription-based library system, schools can book one to four kits a fortnight, covering 40 topics, including: Discarding waste sustainably; Climate change; Electricity; Bones; Human and animal digestive systems; Pests, plant function, and produce. Some examples of the kits are:

Dem Bones / Ngā Kōiwi Tuahiwi

Students explore whole skeletons and individual bones and compare and contrast human skeletons with other species. The kit covers the living world strand with strong links to literacy.

Big Blue Future / Anamata Kikorangi Nui

This resource introduces students to how understanding the ocean is essential to protecting our planet. What does sustainable fishing mean? Why do fish come in so many different shapes and sizes?

Electric Future / Anamata Hiko

Students see how a solar-powered car works and make a battery from salty water and build their own anemometer to investigate the windiest place on the school grounds. The activities build an understanding of electrical currents, conductivity, and insulation.

Climate Change / Huringa Āhuarangi

Students learn about the importance of plants as the 'lungs' of the Earth, investigate ocean acidification and explore the greenhouse effect. Teachers and students are better informed and empowered to care for our planet.

Plants, Pests & Produce / Ngā Tipu, Ngā Kīrearea me Ngā Hua

This kit explores some of the science that supports our primary sector producers. Students identify and discuss the differences between pests and beneficial insects. The parts of a plant are discussed as well as the effects of pests on plant function.

Moo to You / Muu ki a Koe

Students are introduced to how living things are classified, they grow their own pastures, make silage, and participate in a hands-on activity that both explores and compares the stomachs and digestive processes of humans and cows.




(iii) Methodology

Using storytelling methodology and narrative analysis, the students and teachers were placed at the centre of the project. Semi-structured interviews were conducted to capture both students' and teachers' learning experiences with, and perceptions of, the science kits and their impact on student learning from primary to high school and beyond (refer Appendix A for interview schedules).

The data gathered from these stories was examined through a narrative analysis lens to reveal common themes and insights. The stories and identified themes highlighted how the House of Science resource kits impact both learning outcomes and teachers' confidence in delivering science education across various education levels.

LITERATURE REVIEW

"In science, students explore how both the natural physical world and science itself work, so that they can participate as critical, informed, and responsible citizens in a society in which science plays a significant role. Building competencies that endure and have value beyond school should be seen as the overarching purpose of science learning for all students."

(Hipkins et al., 2022)

This literature review discusses the current state and significance of science education in primary and high schools in New Zealand, also citing studies from the United Kingdom. Several reports indicate a varied quality of science education across schools, with some delivering science effectively whilst others face significant challenges. Challenges include resource constraints, teacher confidence, and the need for continuous teacher professional development.

The concept of 'science capital' is identified as a key influencer in students' engagement with the science. Children with higher science capital, where science is integrated into daily life, are more inclined towards science-related careers. Schools are encouraged to build this capital by making science relevant, engaging parents, and collaborating with external entities.

The emphasis on 'future thinking' in the science curriculum is also discussed, preparing students to tackle global challenges effectively. The importance of science education extends beyond knowledge acquisition; it plays a crucial role in enhancing students' critical thinking and problem-solving skills.

THE IMPORTANCE OF SCIENCE EDUCATION IN SCHOOLS

The New Zealand Education Review Office (ERO) has published several reports on science education for young students between 2018 and 2020. A summary of the key findings from these reports reflects while many schools are delivering science education effectively, there is significant variation in the quality of science education across schools. Science education is an important area of focus for New Zealand schools, but there is room for improvement in the quality and accessibility of science education across the education system.

The ERO reports highlight the importance of science education in developing students' skills and knowledge in areas such as critical thinking, problem-solving, and understanding the natural world. However, the ERO notes that many schools struggle to provide high-quality science education due to a range of factors, including teacher confidence, limited resources, and competing demands on classroom time. They also note that science education is particularly important for students from disadvantaged backgrounds, who may have limited opportunities to engage with science outside of school and recommend that schools take steps to ensure science education is inclusive and accessible to all students, including those from under-represented groups.

The New Zealand Tertiary Education Commission (TEC) (2020), in their 'Drawing the Future' report, notes the importance of providing opportunities for students to see themselves as future scientists and the role of parents, educators, and role models in shaping their career aspirations in science, technology, engineering and mathematics (STEM) fields. It discusses the prevalence of children often gravitating towards careers that are familiar to them, pointing out that students' career choices can be influenced by gender and social stereotypes, inadvertently steering them away from considering STEM careers, *"Engagement with role models can also be effective in challenging gender or ethnic stereotyping of engineering and science jobs"* (p. 8). To foster a robust interest in STEM, the report emphasises the need for embedding career-related learning in the curriculum,

challenging stereotypical beliefs about science-related occupations, and implementing supportive teaching practices that encourage students to see science as a potential career pathway.

THE PIVOTAL ROLE OF TEACHERS TEACHING SCIENCE

Shaping effective science education in New Zealand schools.

Research by Anderson (2015) explored how teacher beliefs and knowledge impact science teaching among three primary school teachers in New Zealand. Their beliefs about science teaching were shaped by personal experiences, values, and perceived student needs. External factors, such as interactions with peers, professional development opportunities, and access to resources, also influenced these beliefs, their knowledge gain, and their skills in teaching science. Although their science knowledge levels varied, which affected their teaching confidence, all three teachers identified that they used diverse teaching strategies, including hands-on activities and discussions, to engage students in science learning. Additionally, challenges like limited resources, time constraints, and other academic demands were significant influences. The study concluded that providing teachers with resources, knowledge, and professional development is vital for enhancing primary science education.

Aligning with Anderson's findings, the Education Review Office's (ERO) (2021) paper 'Growing Curiosity: Teaching Strategies to Engage Years 5 to 11 Students in Science', reports on the current state of science teaching and learning for students in Years 5 to 11 and identifies effective practices that enhance student engagement and achievement in the subject. Thirteen New Zealand schools, encompassing primary, secondary, and area schools, were visited. During these visits, lessons were observed, discussions were held with students, teachers, and school leaders, and documentation was reviewed.

The findings from this case study revealed that a majority of students have an interest in science and recognise its relevance to their everyday lives. Effective science teaching was identified by its clear purpose, adaptive planning, and robust assessment practices. Teachers who succeeded in engaging their students employed a diverse array of strategies, including hands-on activities, discussions, and incorporating real-world contexts. However, there were challenges, such as limited resources, teachers' lack of confidence in imparting science education, and inconsistent access to professional learning opportunities.

In light of ERO's findings, the report recommends that schools prioritise science as a core area of learning, ensuring its regular instruction. It also emphasises the importance of teachers participating in professional development to refine their science teaching methodologies. Additionally, it suggests that schools should seek collaborations with external entities, like science institutions and universities, to tap into additional resources and expertise. In conclusion, the paper advocates that engaging students in science learning is pivotal for their prospective success and the broader well-being of society. Effective teaching strategies, when complemented with sufficient resources and professional growth opportunities, can cultivate a passion for science and facilitate a deeper comprehension of the subject.

SCIENCE IN HIGH SCHOOLS

Structured science learning fosters critical thinking and investigative skills.

Science education in high schools is pivotal for understanding critical societal issues like climate change and healthy living. Another ERO study conducted in 2021 raised concerns about the diminishing engagement and achievement of New Zealand students in science as they advance through school. To address this, ERO recommended that school leaders are encouraged to recognise the importance of science, review and enhance their science programmes, and ensure structured learning that builds on prior knowledge. All leading to a fostering of critical thinking and scientific investigations. Additionally, promoting cross-departmental collaboration can integrate concepts from other subjects, providing students with consistent teaching and learning strategies and broadening their academic achievements.

SCIENCE CAPITAL

The sum of all the science-related knowledge, attitudes, experiences and resources that an individual builds up through their life.

Archer and DeWitt (2016), in their longitudinal research study on the science and career aspirations of English youth, found there was a need to increase student participation in science, technology, engineering and math (STEM) programmes to positively impact economic growth, equality, and social mobility. The study, spanning 2009 to 2016, followed a student cohort aged 10-19 years, revealed that while many of them found science interesting, only 16% aimed for science careers post-age 16.

A central concept formulated in their study was 'science capital'. Children from families with high science capital, where science is integrated into daily life and valued, are more likely to aspire to continue with science post-16. The authors recommended that educational interventions should focus on building the science capital of students and families. One effective approach suggested was emphasising the transferability and usefulness of science qualifications beyond traditional science careers. This would help to break the 'science=scientist' mentality and allow a broader range of young people to see the relevance of science in their lives.

Docking (2020) also suggests in her article that schools develop science capital and proposes multiple strategies for schools to cultivate this. She emphasises the importance of integrating science into the curriculum in innovative ways, ensuring it's accessible to all students. For example, linking science to real-world scenarios and students' personal experiences can make the subject more engaging. Also, a positive attitude towards science can be nurtured by making lessons enjoyable and pertinent.

Reflecting Archer and DeWitt's (2016) thinking, Docking (2020) stresses that parental engagement is crucial, as their involvement can significantly influence their children's interest in science. She also recommends that schools can benefit from collaborating with local businesses, museums, and science entities to offer students a broader perspective on science outside the classroom. Lastly, ongoing professional development for teachers is essential, ensuring they remain updated with current scientific knowledge and can effectively foster science capital in students. Through these approaches, schools can create a robust science culture that benefits all students.

FUTURE THINKING IN SCIENCE EDUCATION

"The need for problem-solving and critical thinking in the science classroom in order to better address the uncertainty of future challenges, such as environmental issues."

(Ioannidou & Erduran, 2022).

Jones et al. (2012) work highlights the significance of future thinking in science education, a focus that remains prevalent in the science education literature (Science Learning Hub, 2017; Bull, 2020; Laherto & Rasa, 2022). They emphasise how teachers are central in shaping students' future perspectives through their beliefs, teaching methods, and ability to incorporate future-focused content; all of these factors mould students' views of science learning and future science-related careers. Similarly, Laherto and Rasa (2022) emphasise the significance and relevance of future thinking in the realm of science education, particularly in preparing students for the challenges of the 21st century, such as addressing global issues like climate change and navigating technological advancements.

Bull (2020) also discusses the importance of science education in preparing students for the future, touching on the significance of integrating Māori perspectives into science education in New Zealand. She advocates for science education to be about acquiring knowledge and about developing skills and attitudes that will help students navigate an ever-changing world, highlighting the need for students to be critical thinkers, problem solvers, and effective communicators. In line with Jones and Buntting's (2012) thinking, Bull (2020) emphasises the important role teachers play in fostering a love for science and instilling a sense of curiosity in students.

FINDINGS: KEY THEMES

Eight primary school teachers were interviewed, along with eighteen students from years 5-6 across two primary schools. Nine year 11 students from a high school were also interviewed. The schools are located in the Hutt Valley and Bay of Plenty regions. Several themes were identified across the data from the students' and teachers' stories. These are explained in relation to the three participant groups – the years 5-6 students, the year 11 students, and the primary school teachers – and further described in the recounting of their stories in the next section of this report.

YEARS 5-6 STUDENTS

"The kits are super fun and make science really enjoyable. They help us like science more and we want to learn more about it later."

The students talked animatedly about the science kits, describing how they became a highlight in their learning journey. The sight of these 'blue boxes' (the kits) in the classroom created a mixture of excitement and interest, reminding them of previous lessons and sparking curiosity for 'what's next?'. Five themes from their responses are:

Student Engagement and Enthusiasm: The hands-on nature of the kits has led to heightened student excitement and engagement. The visual cue of the blue boxes is particularly associated with science learning, sparking anticipation and interest.

Collaborative Learning: The kits promote peer teaching, where students get the opportunity to instruct their classmates on certain activities or games. This fosters a collaborative learning environment where students learn from one another.

Enhanced Understanding: The hands-on nature of the kits aids in retention and understanding of information, as they remember and grasp concepts better when they can see and interact with them. Students have the opportunity to conduct a variety of experiments, from creating lava lamps to understanding chain reactions, making science tangible and relatable.

Broadening Perspectives on Science: The kits help students realise that science is not just confined to labs. They are introduced to topics related to nature, environmental conservation, and the broader world, expanding students' understanding of what science encompasses.

Desire for Ongoing Learning: The kits have instilled a deeper interest in science, with students expressing a desire to delve into more advanced topics, including space, chemistry, and potentially riskier experiments.

YEAR 11 STUDENTS

"It helped open my mind even more about the things science had to offer and my interest in it. I would have planned to take science in high school anyway, but it definitely did help."

The students recalled several specific projects they engaged in with the HoS kits, highlighting the lasting impact of the kits on their learning. Their responses to the interview questions indicated the kits had sparked their curiosity and broadened their understanding of various scientific fields. The five themes arising from their recollections include:

Memorable Experiences: They had varying recollections of the science kits, but those who remembered them spoke vividly about specific projects and activities, indicating the lasting impact of these hands-on experiences.

Impact on Curiosity and Understanding: The science kits played a significant role in piquing their interest in science. They found the kits engaging and felt that they provided insights into various scientific fields, broadening their understanding of the subject and interest in pursuing science-related subjects at high school.

Career Aspirations: The science kits influenced some students' views on potential science-related careers. They recognised the broad field of science and the various career options it offers, from physiotherapy to addressing climate change.

Unlocking Curiosity: The science kits introduced students to areas of science they hadn't explored before, emphasising that science is more than just traditional experiments. This exposure enriched their understanding and appreciation of the subject.

Early Years Science Education: Students unanimously agreed on the importance of teaching science to younger students. They believed that early exposure to science fosters awareness, curiosity, and a deeper appreciation of the world.

THE TEACHERS

> *"Teaching science has become so much more enjoyable with these kits. And there's this added sense of responsibility – they make sure I'm covering all the essential topics and aligning with the curriculum."*

The science kits have played a pivotal role in increasing the teachers' confidence in delivering science education by offering comprehensive teaching resources and structured lesson plans that align with the curriculum. This is mirrored in students' heightened enthusiasm and engagement in their learning, with the kits becoming synonymous with excitement and fun. The following five themes highlight the transformative impact of the HoS kits on both teachers' confidence and methodologies, and students' learning experiences.

Boosted Teaching Confidence: The science kits have significantly increased teachers' confidence in delivering science lessons. The structured lesson plans and alignment with the curriculum remove guesswork and provide clarity.

Facilitation of Scientific Discussions: The kits equip teachers to handle student inquiries effectively and stimulate scientific discussions. They serve as a catalyst for curiosity-driven inquiries and deeper understanding.

Transformation in Teaching Style: The interactive and hands-on learning experiences provided by the kits have influenced a shift in teaching methodologies, increasing the emphasis on student discussions and interactive learning.

Collaborative Teaching Practices: Teachers actively share their experiences and insights with each other, fostering a collaborative environment. This sharing of best practices and resources strengthens their knowledge, skills, and confidence in teaching science and builds a strong teaching community.

Professional Development: Although the teachers were not directly asked about the professional development sessions provided through the House of Science's programme, they spoke very highly of these during the interview. Access to subject experts and clear guidance on integrating the kits into teaching practices is seen as invaluable. The kits, combined with the professional development sessions, have made science more accessible and manageable, enabling them to integrate it easily into their regular teaching practices.

THE STORIES

The following stories provide a rich depiction of the students' learning experiences with the science kits and their evident joy in this learning and the teachers' enthusiasm for the kits as they feel more confident and capable in teaching science. Many quotes were gathered during the interviews which provide another source of rich narrative. The year 5-6 student quotes are presented in Appendix B, the year 11 students' in Appendix C, and the teachers' quotes in Appendix D.

Years 5-6 Students

The kits appeared to have a significant influence on the students. Seeing the 'blue boxes' makes them feel excited about learning science and they 'can't wait' for the lesson. The kits have enhanced the learning experience by making science more interactive and fun and inspired the students to think about whether they will have a science-related career or take science subjects at high school. The hands-on approach of the kits, combined with the collaborative learning environment they foster, has made science a favourite subject for all of these students. The following student responses to each interview question provide the narrative and evidence for these points.

The blue science kits: What's the first thing that pops in your head? *(*interview question 1)*
The students talked excitedly about the blue science box (kit), associating it with engaging and fun science classes. They remembered past experiments positively and look forward to learning new concepts when the next kit arrives, knowing they will learn something new.

"I get really excited when I come to class and see the blue science box – I know the lesson is going to be a lot of fun."

"I think of the last time we did science and used the kits. It brings me lots of memories and I am happier that we are doing science."

"I know I am going to learn new stuff and something different. We were doing energy the last time. The blue box reminds me of what we learned before."

The magic of science: How the science kits bring joy to learning. *(*interview question 2)*
The students talked about the science kits as a key factor in making science fun and interactive for them. They enjoy the hands-on experiments and the opportunity to discover answers on their own. Several students emphasised how they liked working together on the activities and teaching each other. The element of surprise in the kits also added to their excitement, as they never knew what activity or experiment would come next.

"The kits make science fun because of the activities and experiments. We do experiments on each other, like the heat detector one."

"There are lots of fun activities that I can do with others. We have to tell the others about the resource or activity we are using. I taught the class a card game for example."

"Working as a group together makes it fun to learn. I get to work with my friends instead of doing independent tasks."

When science gets exciting: Stories of cool kit experiments. *(*interview question 3)*
The students were very enthusiastic about the lessons they experienced using the science kits. They gained insights into human anatomy, such as the number of bones in the skeleton and the fact that babies have more bones than adults. They enjoy the hands-on experiments like creating lava lamps, observing chain reactions, and understanding energy flow. The kits also introduced them to the fun of collaborative challenges, like competing to make the longest paper chain from a single sheet.

"I now know there are 206 bones in the human skeleton and the thigh is the heaviest bone."

"Lightbulb, batteries, wires, and tinfoil – learning how circuits open and close and make the bulb turn on. This was fun to do with classmates."

"We worked on a project with a buddy. This made me feel like it was a competition, which I really liked."

Exploring with science kits: Adventures in learning. *(*interview question 4)*
The students shared that the science kits taught them about testing things and seeing if they change, and learning about chain reactions, which can be small and not always explosive. They find the big reactions really fun. They also realise that science isn't just about labs; it's also about nature and taking care of the planet.

"Testing to see if things work or change. You may come out with a different result from the testing."

"A chain reaction can be a small thing; it doesn't always have to be something to blow up – but that is super fun too."

"The kits help us know that science is more than just labs. They talk about nature and how we can take care of the Earth."

Learning by doing: How science kit activities make learning stick.
*(*interview question 5)*
The students thought that the hands-on activities with the science kits made learning easier and more memorable. By touching and experimenting with the materials, they could understand science concepts better. They liked asking questions and exploring, one student comparing this to "being a detective". They also mentioned that following instructions and listening to their teacher was important. Some kits introduced them to unique and unusual experiments, like chemical reactions, which made the experience stand out.

"The kits make it easier for us to learn because we can touch stuff and do experiments."

"Because it is something really abstract and not normal, like the chemical reaction kit."

"We get to ask lots of questions and find out more stuff by looking things up. It's like being a detective."

From kits to dreams: How science sparks future paths.
*(*interview question 6)*
Using the science kits has sparked a variety of interests among the students. Some have specific career aspirations, such as becoming marine biologists, rocket scientists, chemists, or archaeologists. Others are fascinated by specific topics like explosives, power generation, volcanoes, and space. While some are still uncertain about pursuing a career in science, they stated they are still open to changing their future plans based on their growing love for science through the kits.

"I want to be a marine biologist and study animals."

"I want to blow things up, make explosives like fireworks."

"I've already planned my future, but I can always change it and the more I learn science with the kits, the more I think I probably will."

"I don't want to be a scientist in space or stuff like that. I like science that is about plants and earth."

Ready for more science? The next chapter of science adventures.
*(*interview question 7)*
The students were definitely enthusiastic about continuing their science education in intermediate and high school. The positive experience with the kits has increased their interest in science, with some of the students talking about their eagerness to delve into more advanced topics and make new discoveries. The hands-on experience from the kits has heightened their interest in exploring science in the future.

"Science helps you get smart. If you are asked to do a building competition, you'd have the smarts and be able to do it in detail and win."

"I'm looking forward to learning more science. Scientists discover things way before other people, and they can invent things."

"You get to do more dangerous stuff, so I hope I can do more of that at intermediate."

Year 11 Students

Science kit memories: What stands out the most? *(*interview question 1)*

"Probably my favourite one was the rocket shuttle. We didn't do them that often, maybe once a year, but they were always fun."

The students' recollections of the science kits from primary and intermediate school varied. One student mentioned they didn't remember much about the kits at primary school, but they recalled using them at intermediate. They talked about a project involving bees and decomposition and another related to electricity conduction. For this student, the kits were a special treat that they looked forward to.

Another student also shared that the science kits were considered a special treat. They particularly remembered a kit related to making sherbet and another about rocket shuttles being their favourites. A third student talked about a science kit activity where they made a hovercraft, finding it particularly "cool". Overall, the students' memories of the science kits had varying levels of engagement and recollection of specific activities, but those who could remember using them, talked avidly about their learning experience.

Science kits and learning science: Impact on curiosity and understanding. *(*interview question 2)*

"Yeah, I think that those kits helped me like science and helped me wonder about what we're going to do in high school and in the future in science."

When reflecting on the impact of the science kits on their understanding and interest in science, the students shared a common sentiment of finding the kits engaging and teaching them scientific concepts. They didn't necessarily recall delving into technical aspects of science, but remembered the kits as enjoyable and fun activities and learning. The hands-on experiences definitely piqued their interest in science.

The students also noted that the science kits provided the opportunity to connect with different branches of science. In their primary and intermediate years, science was often presented as a broad and abstract subject. However, the kits provided insights into various scientific fields, offering a sense of the possibilities within the realm of science. This exposure made them curious about science and influenced their outlook on potential future science-related studies and careers. While their specific recollections varied, the consensus was clear: the science kits played a crucial role in fostering an early interest in science among these students.

Taking science-related subjects at high school: Decisions and choices. *(*interview question 3)*

"I didn't really enjoy science until I started using those kits, and after using them, I thought there was actually a more fun side of science as well. I was like, 'Oh, I really need to know more about this."

The students reflected on how their experiences with the science kits in primary and intermediate school influenced their decisions regarding science-related subjects in high school. While they acknowledged their interest in science existed to some extent beforehand, they found that these early experiences deepened their curiosity and broadened their understanding of what science could offer. One student had been involved in a STEM programme at intermediate school and talked in a similar vein about the impact of this learning experience on her interest in science then and now.

Some students noted their learning experience with the kits didn't necessarily make them choose science subjects in high school, however the kits did influence their enthusiasm and interest in pursuing science further. They appreciated how the science kit activities exposed them to more enjoyable and exciting aspects of science, making them keen to learn more. Overall, the students' encounters with the kits and the STEM programme played influential roles in shaping their attitudes towards science and deepening their interest in science-related subjects at high school.

Thinking about a science career: Influence of the science kits. *(*interview question 4)*

"Since using the kits and coming to high school, I've realised just how broad science is, and I'm interested in things related to climate change and the science around that."

For most of the students, their experiences with the science kits during primary and intermediate school played a role in shaping their views on science as a potential career path. There was a common thread in their comments of having an increased interest in, and awareness of, the broad field of science and therefore the career options this offers. Two students said they aspired to be a physiotherapist and a surgeon respectively, recognising the relevance of science in their desired future careers, whilst another student talked avidly about exploring career opportunities in the area of climate change. Others had a more general appreciation for science, enjoying it as a subject even if it may not be their primary career choice in the future.

Unlocking curiosity in science. *(*interview question 5)*

"It sort of gave me an appreciation that science isn't only about mixing chemicals, there's so much more to it."

For these year 11 students, the science kits sparked their curiosity in previously unexplored areas of science, and they appreciated the exposure to different facets of science beyond conventional concepts, for example, building a hoverboard and learning about rockets. Collectively, their experiences contributed to an enhanced understanding that science encompasses "more than just chemical mixing". While the impact of the kits may not have significantly changed their perceptions, they did add a positive and enjoyable dimension to their view and learning of science.

Igniting young minds: The role of early years science education. *(*interview question 6)*

"Science is everywhere, and it's great that younger kids could have more knowledge about it from a younger age, so growing up they could study more about it or see if they want to follow that career path."

All of the students agreed that teaching science to primary and intermediate students is very important, believing that it is crucial because "science is all around us" and provides a foundation for understanding the world. They also thought that science education shouldn't be limited to the 'smartest kids' in the class, but should be accessible to everyone, encouraging curiosity and exploration, and offered the idea that science can be learned at various levels, making it inclusive and appealing to a wide range of students.

In their view, exposing young children to science can help them explore potential career paths and develop a deeper understanding of complex topics. Science is not limited to theoretical concepts but can also involve hands-on, interactive experiences like the science kits they had used. One student talked about science as vital for addressing global challenges, such as finding cures for diseases and mitigating climate change. Overall, they believe early exposure to science education fosters awareness, curiosity, and a deeper appreciation of the world.

What science-related subjects are you doing now? *(*additional question)*

"As we move into years 12 and 13, there are more specialised pathways to explore within science."

In their current academic year at high school, the students are following a general science programme for year 11 that encompasses physics, chemistry, and biology topics throughout the year. This programme includes three external assessments. As they progress into years 12 and 13, there are opportunities to explore more specialised science pathways, such as geology, agriculture, horticulture, and earth sciences. Some students mentioned their interest in studying subjects like Physical Education (PE), recognising that this incorporates scientific elements such as anatomy.

The Teachers

Boosting teaching confidence: The influence of science kits. *(*interview question 1)*

"The science kits have been a game-changer for me, especially since I don't have a strong science background. They are my go-to toolkit, stocked with the equipment and resources I need."

The teachers highlighted that the structure of the kits and the learning resources boosts their confidence in teaching science. The background notes act as step-by-step guides, making them

feel prepared and turning the kits into a readily available science toolkit. They talked about how this has transformed science from a daunting subject to one they confidently teach. The kits also align with the curriculum, enhancing student curiosity and shifting them from passive learners to active knowledge seekers.

As well as boosting their confidence, the teachers observed that students thrive as well, for example, taking ownership of their learning by leading groups and following the kit instructions. Given tight schedules and varied subjects, "these kits are vital", aiding both teachers and students in their science learning journey.

Shaping futures: How the science kits shape student pathways. *(*interview question 2)*

"What's interesting is that students sometimes see 'science' in a limited way. They mostly think of labs, chemicals, and physics formulas. This view can hold them back from seeing all the exciting options that science opens up for them."

When it comes to sparking students' interest in science and encouraging them to pursue science subjects through high school and beyond, the teachers described themselves as having an influential role in giving students a taste of what science is all about. The importance of showing the students a bigger picture was mentioned and how the science kits come into play here. They talked about noticing a change in the students when using the kits – they get more excited about science, and they start thinking about careers they hadn't considered before. Some of them have had chats with students about jobs connected to science, especially careers like being a doctor or a vet.

Handling student enquiries, facilitating scientific discussions: Equipping teachers.
*(*interview question 3)*

"It's great how the science kits open doors to different perspectives. We can integrate Māori viewpoints, making learning more inclusive. Introducing diverse perspectives through the kits is a powerful tool. It creates an environment where everyone's experiences are valued and understood."

The teachers' enhanced confidence in handling student inquiries was largely attributed to the use of the science kits in their teaching. It was evident from their feedback that these kits act as knowledge and resource banks, empowering them to navigate student questions and provide an invaluable toolkit for fostering engaging discussions about science concepts.

They talked about how the background information embedded in the kits is "a lifeline", sharing how the background information and teacher resource book increased their own knowledge and enhanced their ability to respond confidently to student inquiries that arise. Additionally, the kits enable them to introduce diverse perspectives, including te ao Māori worldviews, thereby acting as a bridge to a broader learning experience for students and for the teachers themselves.

Transforming teaching style: Hands-on learning with the science kits. *(*interview question 4)*

"The heart of these science kits lies in their hands-on nature. They're not just boxes of stuff; they're concrete examples that students can really dig into."

This practical element of the kits was described by the teachers as creating a direct connection between concepts and real-world engagement, therefore adding a practical dimension to the students' learning. It became clear that these kits are not just about providing materials, but also providing opportunities for students to touch, experiment, and experience the concepts being taught. Tied into this practical aspect of the kits was the role they play in literacy development. The teachers talked about the reading materials as "providing golden nuggets" that fit into science lessons. They also shared how these kits break away from usual teaching routines, encouraging a shift towards interactive and exploratory teaching styles and student learning approaches.

Engagement shifts: The science kits' Influence on student interest. *(*interview question 5)*

"Seeing the students' reactions when they interact with the science kits is great. They are genuinely excited, and that enthusiasm spills over into their learning."

The teachers talked about a noticeable uptake in students' engagement and concentration when

the science kits are used, especially because of the hands-on experience that these kits offer. This practical element is "like a magnet that draws students in, capturing their attention and sparking their curiosity". From their point of view, the science kits inject fun and enthusiasm into the students' learning experiences, describing how students are not just passively absorbing information, but actively exploring, questioning, and engaging with science. Once again, the teachers mentioned how the science kits also enhance other aspects of the students' skill development such as writing and reading.

Nurturing curiosity: The science kits' role in teacher development. *(*interview question 6)*

"The approach of hands-on activities followed by related tasks has been great. This method goes beyond the science class and across all other subjects."

The teachers acknowledged that relying solely on videos and worksheets (for example) was not enough to engender student interest, and that the practical experiences and applications provided by the kits were beneficial for learning engagement. Because of the kits, the teachers are incorporating other learning methods such as hands-on activities and exploration time in other subjects. One teacher uses the background information and investigation steps learned from the science kits in other subjects and learning activities, stating "the kits have also given us a new vocabulary". Some teachers also talked about implementing strategies like encouraging students to think like scientists and make predictions.

Sharing experiences: Collaborative impacts on science teaching. *(*interview question 7)*

"We've learned that hands-on collaboration amplifies our teaching impact, making science even more engaging."

The teachers agreed that sharing their ideas and experiences from using the kits with each other helped them learn from mistakes, and work out the best ways to engage the students with the learning. They share tips and suggestions with each other and explore together how to improve implementation of the science activities. The idea of structuring regular team meetings to include sharing of ideas and experiences related to the science kits was voiced as a strategy to enhance this collaboration further.

Impacting student decisions to pursue science: The success stories. *(*interview question 8)*

"They are exploring beyond the science class, becoming more curious and some of them are thinking like a scientist. The kits are definitely fostering a love of science in the students."

When asked if they had any specific success stories with using the kits, the teachers talked about observing positive impacts on the students' engagement and interest in science. These included students showing increased enthusiasm for science activities and saying they would be keen to participate in science-related projects, like science fairs, when they get to intermediate school. Interestingly, the students are extending their learning beyond the kits by asking questions and conducting further research on other related topics.

The science kits have also changed the teachers' perception of science as a challenging subject, which in turn is influencing the students' perception as seeing science as fun. The exploration-based learning approach of the kits rather than just following structured instructions, was emphasised as being effective in fostering inquiry-based learning.

The influence of the science kits: Extending students' learning and development.
An additional question asked if the teachers thought the science kits had impacted on students' learning in other ways. They provided several examples, such as vocabulary development, especially by introducing technical terms and the hands-on and exploratory nature of the kits has boosted students' social skills and teamwork, as they learn to work collaboratively in groups and assign leadership roles. Several teachers described how some of their students who may not excel in literacy or maths often take the lead in the science activities, increasing their confidence and providing an avenue for them to excel.

CONCLUSION

This case study report describes the transformative impact of the House of Science kits on both teachers and students. The kits act as knowledge banks, empowering the teachers to navigate student questions and foster engaging discussions, and they have observed a significant increase in student engagement, attributing this to the hands-on approach of the kits. Several of the students in years 5-6 spoke enthusiastically about the prospect of continuing science learning in high school due to their experiences with the kits, addressing one of the three objectives of this project. They have transitioned from being passive recipients to active seekers of knowledge, leading group activities and working together as a team.

Teachers consistently highlighted how the kits, with their structured content and step-by-step guides, have significantly increased their confidence in teaching science, aligning with the project objective aimed at evaluating the enhancement of teachers' confidence and skills in science education due to the kits and support from HoS. The background resources and te reo Māori and English bilingual workbooks have empowered the teachers to address student inquiries. The transition from teaching science with uncertainty to teaching with confidence was evident as they talked about how their perception of science has shifted from a daunting subject to one that they feel equipped to teach and explore alongside their students. All of the teachers talked about the benefits of collaborating and sharing their experiences in using the kits with each other, leading to enhanced teaching strategies and further building their confidence and science knowledge.

It is important to note that the project objective concerning the influence of the kits on students' future career aspirations and their experiences with science during their primary and intermediate schooling was not conclusively determined and warrants further exploration.

The science kits have proven to be invaluable tools in the classroom. They have enhanced the teaching and learning experience, making science more accessible, engaging, and enjoyable for students and teachers alike, resulting in a fostered positive learning environment.

Where to from here?

i. The key learnings and insights gathered from the case studies and narratives can help inform other Food and Fibre CoVE projects, including the High School Transitions and Pathways to VET and Employment project.

ii. There is a potential Phase 2 project to identify other initiatives schools have implemented including where students have participated in related to STEM and/or Food and Fibre. Key insights and learnings from the HoS project will contribute to this broadened scope and complement other projects that the Food and Fibre CoVE are looking at in the high school context.

OPPORTUNITIES

This project provided the opportunity for the House of Science to learn more about how their science kits are perceived in schools in terms of value and benefit to student learning and teacher confidence and ongoing professional development. Based on this evaluation approach and the feedback provided by the students and teachers, the following opportunities are suggested:

1. Implement a formal structured feedback mechanism where teachers and students can provide regular insights on their experiences with the kits. This will aid in continuous improvement and adaptation of the kits to keep meeting learning and teaching needs in the science education realm.
2. Encourage teachers from across multiple schools to collaborate and share their experience and strategies using the kits. This promotes knowledge sharing and another opportunity for teacher professional development on a wider scale.

PROJECT OUTPUTS

1. Case study report with student and teacher[1] stories will be published on the Food and Fibre CoVE and HoS websites.
2. The (anonymised) students' stories will create a compendium to showcase the impact and engagement of HoS with New Zealand schools and students' future pathways in science/science-related fields.
3. Article published in the HoS and Food and Fibre CoVE newsletters.
4. Social media profiling in collaboration with HoS.
5. Case study report to be shared with participating schools and key stakeholders.

1 Names of the teachers (and schools) will only be published with the written consent of the teacher and the school principal respectively.

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APPENDIX A: INTERVIEW SCHEDULES

YEARS 5-6 STUDENT INTERVIEW QUESTIONS

1. When you see a blue science box/kit what are your first thoughts?
2. How do the science kits make science fun for you?
3. What was a fun activity or experiment you did with a kit that made you enjoy science even more?
4. Can you tell me about something cool or interesting you learned using the science kits? Maybe it was a new fact or a scientific experiment.
5. How do the hands-on activities with the science kits help you understand and remember what you learned about science?
6. Has using the science kits made you want to learn more about science or maybe become a type of scientist or do something related to science when you grow up?
7. Are you looking forward to learning more about science at intermediate and high school?

YEAR 11 STUDENT INTERVIEW QUESTIONS

1. What do you remember most about the science kits?
2. Did the science kits contribute to your understanding and interest in science?
3. Has your experience with science kits at primary and intermediate school influenced your decision to take science-related subjects in high school? (If so, can you explain how?)
4. How do you think your experience with the science kits at primary and intermediate school has influenced your overall view on science as a possible career path?
5. Did the science kits spark any interests or curiosity in specific areas of science that you hadn't considered before? (If yes, can you provide an example?)
6. How important do you think it is to teach primary students about science?

TEACHER INTERVIEW QUESTIONS

1. How have the science kits contributed to your confidence in teaching science?
2. How have the science kits influenced your confidence in encouraging students to pursue science subjects at high school and beyond?
3. Do you feel more equipped to handle student inquiries and facilitate scientific discussions because of using the science kits? Please share any instances or examples.
4. Have the science kits encouraged you to incorporate more hands-on and inquiry-based learning approaches in your science lessons? If so, how have they influenced your teaching style?
5. Have you observed any changes in your students' engagement or interest in science since incorporating the science kits into your teaching? Please elaborate.
6. In what ways have the science kits helped you develop your skills in fostering students' interest and enthusiasm for science?
7. Have you collaborated with other teachers or shared best practices related to using the science kits in general, and more specifically, to promote science education? (Has this collaboration impacted your confidence and skills as a teacher?)
8. Can you share any success stories or instances where you have witnessed the impact of using the science kits in general, and more specifically, on students' decisions to pursue science in high school and beyond?

APPENDIX B: INTERVIEW QUOTES – YEARS 5-6 STUDENTS

YEARS 5-6 (CHILDREN AGED 10-11 YEARS OLD) QUOTES:

The blue science kits: What's the first thing that pops into your head? *(*interview question 1)*	*"I get excited and wonder what will be in it this time. I know we will have fun."* *"I think it's a mystery box or a surprise."*
The magic of science kits: How the kits bring joy to learning. *(*interview question 2)*	*"The kits are easy to access; we learn new stuff all the time."* *"We get to do things ourselves and find the answers for ourselves."* *"Learning all about skeletons and the facts about these, like the parts of the body and how much we weigh."* *"I find the kits cool cos I really like learning about bodies – I really really like this."* *"Learning to work together is really good and doing fun challenges."* *"I like surprises; you never know what's going to come out next."* *"It's fun to learn something new and we don't have to write much, we just make lots of creations."* *"The kits are super fun and make science really enjoyable. They help us like science more and we want to learn more about it later."*
When science gets exciting: Stories of cool kit experiments. *(*interview question 3)*	*"I have learned a whole lot of new words for bones."* *"Did you know babies have more bones than an adult. Some bones fuse together as we get older."* *"Seeing a chain reaction made me like science even more."* *"Sometimes you just can't believe it!"* *"The oil and blue colouring kit. You put the pill in water, and it started sparking. It made a lava lamp."* *"Play dough and clay and how energy flows through. We also learn how we can work with this equipment in the future."*
Exploring with science kits: Adventures in learning. *(*interview question 4)*	*"When you do it personally, you remember it versus watching a video."* *"You actually feel how things work."* *"It is way easier when I see something and get information about it, I remember better that way."*
From kits to dreams: How science sparks future career paths. *(*interview question 6)*	*"I really want to do science jobs when I grow up."* *"I want to run tests and figure out how power is made."* *"I am interested in space and astrology; that's what I want to do."* *"I want to be a rocket scientist."* *"I want to find out about extinct animals – archaeology."* *"I want to know how volcanoes erupt."* *"I want to mix chemicals, be a chemist."* *"I want to learn more about robots and how you can control things."*
Ready for more science? The next chapter of science adventures. *(*interview question 7)*	*"Yes, it's great to learn new things. I want to keep learning about space and chemistry."* *"Absolutely. The kits have made me like science so much more. Definitely a thumbs up."*

APPENDIX C: INTERVIEW QUOTES – YEAR 11 STUDENTS

YEAR 11 (AGED 15-16 YEARS OLD) STUDENTS:

Science kit memories: What stands out the most? *(*interview question 1)*	*"I remember doing some sort of thing about bees and decomposition."* *"They were like a special treat. We didn't do them very often, but the one I remember was when we made Sherbet."* *"I remember one where we made these hovercraft things, and I found that really cool."*
Science kits and learning science: Impact on curiosity and understanding. *(*interview question 2)*	*"I found it really useful because of the way of doing sort of the more technical parts of science in a fun way."* *"Yeah, I remember them spiking my interest because it was pretty much the only science class that we actually got to do."* *"I think they gave us an idea of what sort of different sciences we could do later on."*
Taking science-related subjects at high school: Decisions and choices. *(*interview question 3)*	*"They definitely did influence me because there was a point where I wanted to become a vet, but it's quite a difficult career. So yeah, it really sparked my interest and gave me more ideas of specific science subjects I could do."* *"It helped open my mind even more about the things science had to offer and my interest in it. I would have planned to take science in high school anyway, but it definitely did help."* *"The STEM programme I did at Intermediate increased my curiosity about different scientific subjects."*
Thinking about a science career: Influence of the science kits. *(*interview question 4)*	*"I want a science-related career, but I didn't really think of it as a possibility until a lot more recently."* *"I have always enjoyed science, and also I'm thinking of becoming a physio, so I think there is science that is involved with that."* *"I don't necessarily want to do science as a career path, but I enjoy taking it as a subject because I find parts of it interesting."* *"The kits exposed me to science at a younger age, but I only decided on a specific science career more recently."*
Unlocking curiosity in science. *(*interview question 5)*	*"It exposed me to different areas of science, like the hoverboard activity."* *"I think what we did was always a fun activity, which made science seem more positive."*
Igniting young minds: The role of early years science education *(*interview question 6)*	*"Having science in primary school is really important to kind of reaffirm that you don't have to be the best to learn it. As long as you're curious, you're fine. You can go for it."* *"Even if you don't want to take science as a career, it's really important to know the context of how our world actually works, and it will really help in later years with science."* *"You can choose what your level is and kind of explore it from there."*

APPENDIX D: INTERVIEW QUOTES – TEACHERS

THE TEACHERS:

Boosting teaching confidence: The influence of science kits. *(*interview question 1)*	*"Teaching science has become so much more enjoyable with these kits. And there's this added sense of responsibility – they make sure I'm covering all the essential topics and aligning with the curriculum."* *"These science kits have given me a boost of confidence. They're like a safety net, providing content, answers to students' questions, and resources tailored to their needs."* *"I've noticed students taking charge of their learning with these kits. They lead their groups, read instructions, and explore independently – it's incredible to see."*
Shaping futures: How the science kits shape student pathways. (*interview question 2)	*"As teachers, we're like the gateway to a world of science. We want our students to not just learn, but to really enjoy the subject."* *"When it comes to talking about high school choices, science often takes a back seat. It's not something that's always on our radar. "I've had a few chats with my students about careers in science, like being a doctor or a vet. It's eye-opening to see their interest."* *"Students sometimes think science is all about labs and chemicals. Our goal is to broaden students' views on science. It's not just labs; it's also about nature and the environment."* *"With the science kits, I've seen a shift in my students. They're more excited and curious about where science can take them."*
Handling student enquiries, facilitating scientific discussions: Equipping teachers. *(*interview question 3)*	*"The background information in these kits is gold. It definitely helps me handle discussions that my students are curious about."* *"Prepping with the kit's background information makes me feel like I'm on top of my game. I can tackle student questions with confidence."* *"The extra resources in these kits are a treasure trove. They empower me to give my students answers that are both thorough and accurate."* *"The kits go beyond what's expected. They give me the tools to provide my students with insights that enrich their understanding and enjoyment of science."* *"One thing I love about these science kits is how they allow me to offer my students a complete picture. It's like having an expert by my side."*
Transforming teaching style: Hands-on learning with the science kits. *(*interview question 4)*	*"These science kits are like sparks for innovation in our teaching. They encourage us to use hands-on and inquiry-driven methods that really engage our students."* *"The kits go beyond the hands-on aspect. They weave literacy into the students' learning."* *"These kits provide students with real, tangible examples. It's like turning abstract concepts into something they can touch and interact with."*
Engagement shifts: The science kits' influence on student interest. *(*interview question 5)*	*"It's like the classroom transforms when we bring out the science kits. Suddenly, everyone's more engaged and focused on what's happening."* *"They can't wait to start using the kit."* *"The moment I introduce the science kits, their eyes light up and they are eager to learn."*

Nurturing curiosity: The science kits' role in teacher development. *(*interview question 6)*	*"What I learned from science kits became a toolkit for me. I use those strategies in different areas of my teaching, increasing the learning experience."* *"We have realised that practical experiences are a key to student engagement Hands-on learning brings a whole new level of excitement and understanding."* *"The strategies we've discovered through science kits have broader implications to our teaching and to the students' learning."*
Sharing experiences: Collaborative impacts on science teaching. *(*interview question 7)*	*"Yes, we do talk to each other about our experience with the different kits. Sharing tips helps us know what strategies will work best and what potential student learning challenges we need to be aware of."* *"Through working together and talking with each other, we're finding new ways to use science kits."*
Impacting student decisions to pursue science: The success stories. *(*interview question 8)*	*"The kits have really changed how students view science. They are always excited to see a kit when they come into class."* *"The kits are definitely fostering a love of science in the students."*

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